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THOMAS (C. A.). **Studies on the Fusarium-wilt disease of the Sweet Potato (Ipomoea batatas Poir.).**—*Proc. La Acad. Sci.*, vii, pp. 23–24, 1943.

In studies on *Fusarium batatatis* and *F. hyperoxysporum* [*F. bulbigenum* var. *batatas* and *F. oxysporum* f. 2: *R.A.M.*, xxii, p. 456] from sweet potato in Louisiana, the former was found to be less pathogenic than the latter. Variations in cultural characters were not common. No sectoring was noted. By selecting a single macro- or microconidium the production of macroconidia was increased, the increase being greater in *F. oxysporum* f. 2 than in *F. bulbigenum* var. *batatas*. The identification of these fungi was based on the growth characteristics on a rice medium and on potato cylinders. *F. bulbigenum* var. *batatas* presented a powdery appearance on potato, and when the stroma covering the substratum became shrivelled, many small, blue blisters of sclerotial plectenchymata formed. *F. oxysporum* f. 2 on potato first produced abundant white mycelium and after drying had a gelatinous appearance. On rice medium the former produced a powdery orange colour, dark blue to purple blisters appearing on the substratum in age, while *F. oxysporum* f. 2 produced a dark red colour, turning blue in age. This fungus is more prevalent than *F. bulbigenum* var. *batatas* in Louisiana.

PRYOR (D. E.). **The big vein disease of Lettuce in relation to soil moisture.**—*J. agric. Res.*, lxviii, 1, pp. 1–9, 1 fig., 2 graphs, 1944.

Experiments on the relation of soil moisture to big vein of lettuce [*R.A.M.*, xxi, p. 513], a disease of obscure etiology transmitted by the soil, were carried out in pots with two different soils from affected areas in California, one near Salinas and the other in the Imperial Valley. The results showed that the number of plants developing the condition increased as moisture increased from 35 to 85 per cent. of capacity. Many diseased plants were present even at moisture levels below the optimum for lettuce, and a few plants became affected when supplied with only enough water to keep them alive. Incidence was highest in the treatments that gave the largest plants.

With each increment of moisture plant weight increased. In each series the most vigorously growing lettuces appeared to be those most readily affected, but the earlier a plant developed the condition the smaller was its final weight. Diseased plants raised on Salinas soil seemed to be larger than healthy plants in the same pot, while the reverse was true on Imperial Valley soil, the difference being attributed to the larger growing period for plants on the latter soil.

It is recommended that resistance trials should be carried out in well-watered soil. There appears to be little hope of reducing big vein in commercial fields through the control of soil moisture.

WALKER (J. C.). **Histologic-pathologic effects of boron deficiency.**—*Soil Sci.*, lvii, 1, pp. 51–54, 1944.

This is a condensed version of the author's studies (with J. P. Jolivette) on the pathological histology of boron deficiency in the garden beet and cabbage, already

noticed from another source [*R.A.M.*, xxii, p. 335]. A common observation in beets grown for canning in Wisconsin is the sudden appearance of internal black spot just before harvest notwithstanding liberal applications of borax. Such was the case, for instance, in the Green Bay area in 1942 after 50 lb. per acre applications, and in the Racine-Kenosha district in 1943, where the disease affected up to 25 per cent. of the roots after treatment of the soil with 75 lb. borax, broadcast with the 3–12–12 fertilizer (1,500 lb. per acre) and thoroughly worked in before planting. No attempt is made in this paper to explain the inadequacy of borax in the cases under investigation.

Plant virus diseases and their control. Transactions of the conference on plant virus diseases, Moscow, 4-7/II 1940.—340 pp., 68 figs., 3 diags., 10 graphs, 2 maps, Moscow-Leningrad, Acad. Sci. U.S.S.R., 1941. [Received February, 1944.]

This account of the conference on plant virus diseases held in Moscow during February, 1940, contains the following interesting reports.

B. L. Issachenko (pp. 7–9) advocates the training of greater numbers of virus research workers and the establishment of a special virus research centre, preferably as part of the Academy of Sciences.

M. S. Dounin (pp. 22–35) states that at the present moment virus research work in the U.S.S.R. is concentrated in the Plant Virus Laboratory of the Microbiological Institute of the Academy of Sciences and in the Virological Laboratory of the Institute for Plant Protection. In addition, several virus specialists are working at a number of provincial institutes for various crops and at agricultural experiment stations.

M. I. Goldin (pp. 36–48) examined crystalline inclusions in the tissue of living tomato plants infected with the virus of tobacco mosaic [*R.A.M.*, xxi, p. 473] by means of a special apparatus [which is described] and found that the inclusions remained unchanged for an indefinite period. Calculations based on the weight of crystals per unit of leaf space showed that a considerable proportion of the virus material present in the infected plant is contained in the crystals. Observations on the hairs of young tomato plants infected with the virus of tomato aucuba mosaic [ibid., xxi, p. 169] showed that four types of inclusions are typical of that virus, all four being fundamentally identical: X-bodies which are composed of a bunch of small fibrillar nets; small fibrillar nets; Ivanowski's crystals of a polymorphic type which are formed either from X-bodies or independently of them; and long fibrillar threads or needles (Smith's spike crystals). It is suggested that the presence of crystalline inclusions and their type can be used as criteria in the identification of virus diseases.

K. S. Souchov (pp. 68–81) sums up the available knowledge on 'zakooklivanie' [pseudo-rosette: see below, p. 211; ibid., xxi, p. 9] of cereals, and states that an important factor in limiting the activity of the vector, *Delphax* [*Delphacodes*] *striatella*, is the parasitism of *Pristogenetopus conjunctus*. In 1939, 2 to 4 per cent. of the hibernating generation of the vector was infected by this parasite and 18 to 25 per cent. of its first summer generation. Another enemy of the vector is the larva of a ladybird which was observed to destroy great numbers. Pseudo-rosette occurs in the Far Eastern region, in Eastern and Western Siberia, the Karaganda, and the Kirov and Voronezh districts of European U.S.S.R.

A. M. Vovk (pp. 82–106) reports on the effects of mulching and watering on pseudo-rosette disease of oats observed in 1939. Oats grown in plots with 200 plants per sq. m. had 77·6 per cent. total infection (33·8 per cent. showed the milder symptoms of mosaic) when mulched with white paper, 100 per cent. when mulched with peat or left unmulched as a control (both these series also showed a predominance of the severe type of symptom, stunting), and 99·8 per cent. (97 per cent.

stunting) when watered twice during the growing season. Measurements of the soil temperature in these plots at depths of 6, 10, 18, and 25 cm. showed that it had no effect on the disease. Counts of the first generation of *D. striatella* (which is the generation mainly responsible for the spread of the disease) showed that fewer insects were present in plots with white mulching paper (57 insects per sq. m.) than in the control plots, plots mulched with peat, or those watered, which had 206, 161, and 146 insects per sq. m., respectively. Similarly, in plots with 90 plants per sq. m., the corresponding figures were 50, 129, 69, and 98 insects, respectively. When, however, the insects were forcibly introduced into the plots protected from all sides to prevent escape, plots with white mulching paper had 98·6 per cent. infection as compared with 77·8 in the control exposed to free visitation by the vectors, demonstrating the predominant importance of the insect in the incidence of the disease. The exact nature of the obviously repellent action of the white mulching paper on the vector is as yet unknown. It is worthy of mention that plants grown on white or black mulching paper, whether healthy or diseased, were more vigorous than the controls, grew higher, formed more branches, gave larger yields, and were more drought-resistant. In studies with other cereals conducted in 1939 in Omsk pseudo-rosette disease was transmitted by means of non-sterile larvae of *D. striatella* from wheat to oats, rye, wheat × couch grass hybrids, maize, and barley; and from oats to wheat, rye, wheat × *Agropyron* hybrids, maize, barley, millet, and sorghum. The incubation period on all hosts was eight to ten days. Pseudo-rosette disease did not cause in wheat, rye, and wheat × couch grass hybrids the greening of inflorescences and excessive branching found in oats. It is considered as proved that the mosaic disease of wheat in the Omsk district is identical with pseudo-rosette. During 1939, less susceptible varieties of spring wheat suffered in the field 10 to 25 per cent. infection, and the more susceptible 20 to 50 per cent.; barley showed 30 to 40 per cent. infection; the percentages of infection were even higher in nurseries. Rye, both in the field and in nurseries, had only 0 to 2 per cent. infection, and millet up to 6 per cent. Denser sowing was again shown to reduce the incidence of disease: barley sown at the rate of 120 kg. per ha. had 60 per cent., and at the rate of 170 kg. only 30 per cent. infection. Winter wheat was less infected in the Omsk district when sown in the last ten days of August than when sown earlier; such disease as occurred was apparently due to infection next spring. None of the wheat or barley varieties tested was immune from the disease; the most resistant were the wheat varieties Lutescens 0956, Smena 01021, Caesium 0111, Leucurum 05383, and the hybrid 94/14530 (cross of Caesium with Dicoccum), with infection ranging from 11·9 to 25 per cent., and the barley varieties Nutans, Nutans 061162, Nudihas-hax, and Pallidum A-4127, A-4271, and A-4270, with from 10·3 to 28·1 per cent. infection. Rye proved generally very resistant, while wheat × rye hybrids were very susceptible. Wheat × *Agropyron* hybrids showed little susceptibility in the F_1 to F_3 populations, but later both resistant and susceptible types occurred.

S. D. Grebennikov (pp. 107–119) proposes the name pseudo-rosette for the disease of oats previously described as 'zakooklivanie'. The results of a study conducted in Siberia from 1934 to 1939 showed that the disease is not transmitted through the seed. Its development is favoured by excessive soil moisture during the early stages of plant growth, and often coincides with an increased activity by the larvae of Elateridae. Vernalization reduced the percentage of disease in the oats varieties Victory and Gold Rain from 62·3 to 12·5, and from 68·5 to 16·8, respectively, in 1939; and from 12·8 to 4·4 and 13·2 to 5·2, respectively, in 1937. In fertilizer trials at Omsk in 1937 the addition of phosphorus to the soil decreased the percentage of diseased plants to between 2 and 4, and that of nitrogen increased it to between 28 and 33 as compared with 13 to 15 per cent. in the unfertilized control. The author's observations led him to believe that there is no

definite correlation between the date of sowing and the incidence of the disease. The latter depends mainly on high humidity of the soil and air combined with low temperature at certain phases of plant growth, and may, therefore, vary from year to year and from locality to locality. The percentage of diseased plants was much decreased by loosening the soil between rows of oats by either ploughing (from 18·4 per cent. to 3·8) or hoeing (from 24·6 to 4·8), once after emergence and again before tillering. Other factors having a limiting effect on the disease are deep sowing (5 to 8 cm.) on light soils, the cutting and destruction of weeds, and the burning of stubble in the autumn followed by deep ploughing. In crop rotation, potato, fallow, onion, and poppy encourage subsequent disease development in oats, while pulse is unfavourable to it. To demonstrate the importance of certain agrotechnical practices two parallel experiments were conducted; in the first only large seed, selected by hand and vernalized, was sown at the rate of 2 zentner [100 kg.] per ha. at a depth of 6 to 8 cm. in rows 8 to 10 cm. apart, while the field received after emergence 30 kg. each of potash and superphosphate and was cultivated after fertilization and again during tillering; in the second, non-selected, non-vernalized seed was sown at the rate of 0·8 zentner [40 kg.] per ha. at a depth of 3 to 4 cm. in rows 28 to 30 cm. apart, and the plots received no fertilizer and were not hoed or cultivated. The percentage of diseased plants in the first plot was 1·2 as against 24·2 in the second. The cultivation outlined for the first plot is recommended as a basis for the control of the disease.

Mme V. A. Bruizgalova (pp. 120–132) states that in experiments conducted near the Baikal Lake, Eastern Siberia, pseudo-rosette of oats was transmitted by sterile *D. striatella* individuals to wheat, producing 41·6 to 80 per cent. infection and causing the formation of deformed, whitish, sterile ears. This symptom is locally known as 'curl', and the result of the experiment is taken to have established the identity of this disease with pseudo-rosette. Artificial infection of oats in the early stages of growth (coleoptile, first, and second leaves) gave 17 to 26 per cent. severely dwarfed plants, at the beginning of tillering 16 per cent. dwarfs, at the stage preceding heading 1 to 2·5 per cent. infected plants with only mild symptoms, and at the heading stage no sign of infection whatsoever. Oats sown on a plot receiving the normal amount of sun developed 8·6 per cent. dwarfed plants with either proliferated heads or none at all, while those grown on a completely shaded plot, though showing 13·7 per cent. infection, had an almost normal appearance and only proliferated ovaries and deformed grains. Counts of *D. striatella* throughout the season of 1939 showed that 415 to 472 insects per standard sample were present over oats fields, 258 over adjacent pasture land, 7 to 32 over wheat fields, and only single individuals over fields of winter rye, American couch grass [*Agropyron repens*], or pastures more than 500 m. distant from oats fields. Eggs of the first population of the insect were found primarily in oats plants (47 to 63 per cent. plants in one field); of the weeds encountered in oats fields, *A. repens* harboured eggs, but the percentage of infected plants of this species did not exceed 12. Eggs of the second generation were found primarily on *Setaria viridis* (on 66 per cent.) and *Galeopsis tetrahit* (on 54 per cent.); on steppe land an abundance of eggs was also found on *Scutellaria scordiifolia*. In crop-rotation experiments oats following oats had 19·8 and 8·7 per cent. infection on high and low ground, respectively, while oats following summer rye or wheat (both on high ground) had 4·8 and 5·3 per cent., respectively. In years favouring a high incidence of the disease oats sown after 25th May showed less infection than those sown earlier. Oats stands with 610 plants per sq. m. showed in 1938 $14{\cdot}2 \pm 1{\cdot}4$ per cent. infection as compared with $35{\cdot}4 \pm 2{\cdot}7$ in those with 312 plants; similar results were obtained in 1936 and 1939. This consistently higher incidence of disease in thinner stands is believed to be partly due to the greater number of vectors present and partly to the greater amount of light.

S. V. Petrukovich (pp. 133–139) reports that pseudo-rosette of oats was observed for the first time in the Kirov district in 1938, where it represents the most serious disease of that crop, causing up to 20 per cent. infection in the field and up to 80 per cent. in experimental plots. None of the oats varieties tested showed any consistent resistance to the disease.

S. S. Khairullin (pp. 140–144) records that pseudo-rosette of oats causes up to 65 per cent. infection (or an average of 37 per cent. for five years) in the Transbaikal district of Eastern Siberia. The prevalence of the disease is stated to vary largely from year to year, and in any one year from one locality to another. Barley was attacked to the extent of 60·2 per cent. in 1936. All varieties of oats and barley tested proved more or less susceptible to the disease; the most promising strains of oats belonged to the *volgensis* group, and of barley to the forms from Abyssinia and Eritrea (var. *deficiens*). Other tests confirmed the results obtained elsewhere with regard to the higher incidence of disease in thinner stands and lower sites. The incidence was found to be higher on badly cultivated land and on heavy soils than on well-ploughed land and on sandy soil.

L. F. Russakov (pp. 145–152) gives the available data on the incidence of certain virus diseases of crops. Pseudo-rosette was particularly severe during 1939 and most prevalent in the forest-steppe and steppe zones of Western Siberia, where the oats variety Gold Rain suffered between 66 and 99 per cent. infection; the disease was less severe in Eastern Siberia and almost absent from the European U.S.S.R. Wheat and barley were attacked to a lesser degree. None of the oats varieties tested was resistant to pseudo-rosette, but some were considerably less susceptible than others, varying, however, in their reaction according to the district. Generally, early-ripening oat varieties seemed to be more susceptible than the late-ripening. Bean varieties differed greatly in their resistance to mosaic [ibid., xi, p. 417], the least susceptible being Tepary from Arizona.

V. K. Zazhurilo and Mme G. M. Sitnikova (pp. 153–164) state that reductions in yield of winter and summer wheat and oats caused by mosaic [ibid., xxii, p. 59], as measured on individual plants in the field, amount to between 40 and 100 per cent. the weight of grain. It is considered that mosaic is more closely related to pseudo-rosette than to any other virus disease of cereals, but differs from it in producing no protein crystals in plant cells, having no proliferation or masked mosaic symptoms, a different species of vector, and a longer incubation period. It is considered that the virus of winter wheat mosaic, as it is proposed that it should be known, is new to science. Five years' observations in the Voronezh district showed that winter wheat mosaic is capable of infecting *Setaria glauca*, *S. viridis*, and, very slightly, *Calamagrostis epigeios*. Density of stand was found to influence the incidence of mosaic. Thus, 6·2 per cent. infection occurred in oats continuously sown at the standard rate as against 64 per cent. in oats sown in rows at a lower rate. Winter wheat (Hostianum 0237) sown at the rate of 140 to 160 kg. per ha. showed 7·8 per cent. infection as against 14 per cent. when sown at the rate of 30 kg., and 22 per cent. when sown at the rate of 15 kg. Early sowing dates are recommended for summer crops and later ones for winter wheat. Of the three populations of the vector, *Deltocephalus striatus*, which commonly develop during a season, only the third, the autumn one, is of importance in the infection of winter crops, while the first is responsible for the infection of summer crops. Mass infection in the spring occurs when early hatching of the insects coincides with an early phase of plant development.

S. N. Moskovets (pp. 173–190) considers that the virus disease of cotton in Azerbaijan [ibid., xvii, p. 392] is not identical with leaf curl occurring in the Sudan. Local symptoms do not include the protruding nervature or the cup-like outgrowths on the lower side of leaves characteristic of the Sudan disease; the sap of healthy plants is pink and that of diseased ones light brown as against reddish-blue and

bright green, respectively, in the Sudan; the vectors are different in the two countries and so are varieties showing resistance to the disease. To avoid confusion of the two diseases it is proposed to name that in Azerbaijan 'cotton curliness'. The disease is stated to have been steadily increasing since its discovery in 1934. In one test the disease caused a reduction of 55 per cent. in the number of bolls formed; in another a reduction of 72·9 per cent. was caused when infection occurred early in the season, the percentage gradually falling to 35·5 with progressively later dates of infection. The number of bolls formed on plants with severe, medium, and slight infection was by 60, 30·7, and 12 per cent., respectively, smaller than that on a healthy one. The susceptibility to cotton curliness varied from variety to variety, the average reduction in yield ranging from 16·2 to 55·6 per cent., and within a variety from one locality to another. It is estimated that in years with severe infection susceptible varieties may suffer losses in yield up to 9·5 per cent. The disease also affects the quality of the cotton fibre, reducing its length by about 7·5 per cent. and lessening its absolute strength by from 3·3 to 16·6 per cent. for different varieties. The average absolute weight of seeds from diseased plants was 11·2 per cent. lower than that from healthy ones. The virus from cotton was successfully transmitted by *Aphis gossypii* or by infusing infected sap into decapitated stems of healthy plants to *Gossypium barbadense* and its variety *maritima*, and to *G. hirsutum*; similar symptoms were produced on *Hibiscus cannabinus* and *Solanum dulcamara*. Three years' experimental data showed that under local conditions *A. gossypii* is the most important vector (85 to 100 per cent. successful transmissions), *A. laburni* (6·1 to 16·6 per cent.), *Myzus persicae* (12·5 to 25 per cent.), and *Epitetranychus althaeae* (7·7 to 10 per cent.) playing a secondary part. The incubation period of the virus varied from 35 to 56 days. In field tests conducted for four years and under experimental conditions with isolation from insects, evidence pointed to the possibility of seed transmission. When cotton was sown in strips of three, four, or five rows each, with a distance of 140 cm. between the strips, the infection percentages were 3·2, 2·9, and 2·7, respectively, substantiating the previous conclusion that less disease occurs in denser stands. The average percentages of infection were 15·5, 19·8, 54·8, and 88·8 following sowings in April, May, June, and July, respectively, the higher incidence in the summer-sown plants being at least partly due to higher temperatures of soil and air. Some cotton varieties were resistant to the virus; the most promising among those bred in Azerbaijan are strains of *G. barbadense*, such as Giza 7 and 3782–1 (from Giza 12), and of *G. maritima*, such as Nos. 1, 2, and 7, and among those bred in Russian Central Asia, 6081, No. 15, 263, 4623*a*, and 35–1. For the control of cotton curliness the author suggests the growing of resistant varieties, roguing of infected plants, separate harvesting from healthy and diseased plants to ensure healthy seed for the next year, and control of vectors.

V. L. RYJKOFF and Mme T. P. OVCHAROVA (pp. 191–196) describe the anatomical changes produced by the virus disease of cotton found in Azerbaijan [see above]. They consist in a thickening of the leaf lamina, the presence of excessive starch in the lamina and petioles, underdeveloped bast fibres in the petioles, and underdeveloped roots, which are poor in starch. The disease is considered to be a special type of yellows, although it lacks the hypertrophy and necrosis of the phloem usual in this group of virus diseases, and produces an unusual hypoplasy of the bast fibres. It differs from the leaf curl disease of cotton in the Sudan in the following points: in Azerbaijan the diseased leaves tend to curl upwards, the palisade parenchyma is more strongly developed than in healthy plants, no additional cylinders are formed in stems and petioles, and the bast fibres are hypoplastic; in the Sudan the diseased leaves mostly curl downwards, the palisade parenchyma is either underdeveloped or not developed at all, and additional cylinders are formed in stems and petioles. It is suggested that the two diseases

are distinct, and it is proposed to name that in Azerbaijan 'leaf roll' and the virus causing it, according to K. M. Smith's classification, *Gossypium* virus 2, Verderevsky.

L. K. KARA-MURZA (pp. 197–202) found in a physiological study of the Azerbaijan virus disease of cotton that the leaves of diseased plants contain less total and albuminous nitrogen and both leaves and petioles have more carbohydrates, particularly starch, than those of healthy plants, the amount of carbohydrates in the reproductive organs and in the stem walls being, on the other hand, smaller; furthermore, the accumulation of dry matter is less intense, and the amount of chlorophyll smaller.

I. P. KHUDYNA (pp. 203–218) has conducted since 1936 an exhaustive study of virus diseases of tobacco and Indian tobacco, as a result of which the 20 types of disease attacking these crops in the U.S.S.R. are classed in the following seven groups: (1) tobacco mosaic, (2) cucumber mosaic, including white pickle, (3) severe etch, (4) ring spot, (5) wet 'montar' or 'stolbur' [tomato big bud virus], (6) leaf curl, and (7) crinkled dwarf (not yet identified). Most of these diseases occur throughout the tobacco-growing regions except leaf curl, which has been observed only in Georgia and the Central Asian Republics, and crinkled dwarf which is apparently restricted to the Krasnodar district. All except big bud decrease the yield and the commercial quality of tobacco; big bud not infrequently increases the yield and the chemical quality of tobacco leaves, but owing to an intensified hygroscopicity these leaves dry badly and easily go mouldy, and are therefore considered unfit for production. It was proved experimentally that neither tobacco mosaic nor big bud, cucumber mosaic, leaf curl, or crinkled dwarf are seed transmitted, whereas white pickle, etch, and, in one test ring spot, were transmitted through seed. Contact of the roots of healthy transplants with chopped leaves infected with tobacco mosaic virus gave 17·8 per cent. infection. It is considered that white pickle, cucumber mosaic, etch, and ring spot are not spread through hands of workers to any considerable extent. Big bud, which in some years infects 50 to 60 per cent. of the crop and causes great losses, is not spread through the seed, soil, or plant remains in the field and is transmitted artificially only through grafting of diseased eyes or petioles on to healthy plants. Its vector, if any, is as yet unknown. The identity of wet 'montar' with 'stolbur' and big bud is considered to be established beyond any doubt. It is most prevalent in years with wet summers and its development is favoured by mulching. The virus of big bud was detected in bindweed [*Convolvulus arvensis*], the presence of which in tobacco plots was found to increase the incidence of disease in the crop. Other hosts of this virus are *Nicotiana rustica*, *N. glutinosa*, and *N. sylvestris*.

In the control of tobacco mosaic it was found necessary to extend the period of exposure of equipment to formalin solution (1 : 25) from one to four days as the virus was inactivated only after this time. The incidence of tobacco mosaic was lowest where tobacco followed cereals in crop rotation, higher where grown for two years, and highest where grown for three or more years in succession. Eradication of diseased plants prior to harvest decreased the incidence of tobacco mosaic by 2·5 to 4 times: but this measure is only recommended where the number of diseased plants in a field does not exceed 1 or 2 per cent., as with higher percentages the resulting thinning of stands would impair the quality of the crop. Treatment of seedlings with 1 per cent. Bordeaux solution reduced the percentage of mosaic-diseased plants at the end of harvesting to 4·3 from 12·25 in the untreated control. This treatment, however, can only be applied in regions with sufficient moisture, as in arid zones it tends to influence transplantation unfavourably.

For the control of those virus diseases which are transmitted through seed, the following heat treatment has been evolved: seeds with an initial moisture content of not more than 6 per cent. are heated in a thermostat, in which the temperature

gradually rises from 30° or 40° to 90° C., for four hours if piled up in a layer of 1 to 2 cm. thickness, or for 7 to 8 hours if put into bags holding 1 kg. each; exposure to the temperature of 85° or 90° must last at least one hour. The incidence of white pickle in plants grown from heated seed ranged from 2·9 to 7·2 per cent. as against 6·3 to 16·5 for the unheated control; the corresponding figures for ring spot and etch (combined) in tobacco were 1 to 2·28 as against 2·1 to 5·2 per cent., and in Indian tobacco 1·9 as against 7·3 per cent. In farm experiments the heat treatment of seeds increased the yield of tobacco by about 15 per cent. and that of Indian tobacco by about 13 per cent.

V. M. Poner (pp. 227–244) found that the length of the incubation period of the virus causing 'stolbur' in tomato varies greatly in different varieties. It is suggested that in the absence of immune varieties a promising line of work is to cross varieties which have long incubation periods with quickly-ripening ones, as progenies from such crosses might be able to escape much of the 'stolbur' injury. *Solanum nigrum*, with a very long incubation period, exhibited a higher degree of resistance to 'stolbur' than tomato. By grafting, the disease was transmitted to potato, causing a gradually increasing chlorosis of the leaves followed by complete necrosis and an upward curling of the leaf laminae; some plants developed aerial tubers with several small leaves sprouting from them, while subterranean tubers were abnormally small and often deformed. The virulence of the virus in the tomato was found to increase with successive transfers (by grafting) from plant to plant: after the first transfer 20 or 25 per cent. of plants in the plot became infected and the symptoms were very slight, while after the third transfer there was 74·4, and after the eighth 66·6 per cent. infection, with pronounced symptoms in both cases.

Y. M. Reydman (pp. 245–254) reports that during 1939, 50 to 70 or even 90 per cent. of the tomatoes in the Crimea were suffering from 'stolbur'. The losses resulting from this disease depend upon the time of infection, the stage of plant development at that time, and the variety of the host. It was calculated that every 1 per cent. of plants of a moderately quick-ripening variety succumbing to infection before the beginning of September results in a 0·5 per cent. decrease in the general yield of fruits. During 1939 the disease is known to have been prevalent also in the Krasnodar, Eysk, and Frunze districts, and in the Moldavian Autonomous Republic. In the Crimea the intensity of infection varies from year to year and in any one year from locality to locality, according to meteorological conditions. High temperatures of soil and air are generally favourable to the disease. However, when a period of drought is interrupted by abundant rains, 'stolbur' development following these rains is more intense than in completely dry seasons. Similarly, intensified disease development was found to occur after extensive watering of the tomato plants during a hot spell. This is explained by the fact that rains or watering encourage the growth of tender new shoots, on which the symptoms are more marked. Late dates of transplanting insured healthier plants than early ones, as it appears that plants entering the hot period, which is that of infection, when still young, suffer less from the attack than older ones. On the other hand. plants which contrive to set sufficient fruit on the lower trusses before the onset of heat give good yields in spite of infection, whereas plants still undeveloped at that time bear no fruit at all. It is suggested that good yields can be obtained by early planting of quickly-ripening varieties such as Bison, which yields most of its fruit crop before the outbreak of 'stolbur'. In any case, care should be taken to raise vigorous seedlings. Comparative trials showed that the yields of Bison for the whole season (the bulk is ripe before 1st August) were consistently higher than those of the late-maturing Market's Marvel (all but a fraction ripens after 1st August). The planting of shade screens of maize or sorghum between the rows of tomatoes reduced the yield in every instance. This is attributed to the fact that

plants grown as shade screens develop comparatively late and become effective only after the tomato plants have already suffered from the effects of heat. In addition, these plants consume much of the nutritional matter in the soil, depriving the main crop of the benefit of it. Mulching with straw increased the yield by 12 to 45 per cent. and decreased the percentage of 'stolbur' infection as compared with the control. Dense stands, planted 100×30 cm., showed larger yields and smaller percentages of 'stolbur' (305 zentner per ha., 26·3 per cent.) than the usual plantings at 100×60 cm. (248 zentner per ha., 51·1 per cent.). Watering at night during the hot months gave better yields and less 'stolbur' than watering during the day. Extensive trials and observations have shown that tomatoes of the *validum* group are generally more resistant to 'stolbur' than those of the *esculentum*. Varieties of the former group, such as the late-ripening Stone, are recommended to ensure the supplies of tomatoes in the presence of 'stolbur'.

B. I. Serbinov (pp. 264–268) states that 'stolbur' of tomatoes is one of the most prevalent and serious diseases in the Moldavian Autonomous Republic. In recent years it has been on the increase, affecting 20 to 25 per cent. of plants in the field in 1937, 35 to 40 in 1938, and 50 to 75 in 1939. The disease is favoured by the prevailing weather conditions in the summer: droughts interrupted by infrequent downpours of rain. The disease usually appears during July. Of the control measures tested, mulching reduced the percentage of 'stolbur' infection from 20 to 10 and increased the yield; spraying with 1 to 1·5 per cent. lime solution reduced the infection from 20 to 14·2 per cent., but also depressed the yields; spraying with 1 per cent. Bordeaux mixture reduced the infection from 40·7 to 29, 20 to 14·8, and 66·6 to 46·6 per cent. without harmful effects on yield; planting tomatoes between the rows in an orchard resulted in only a slight amount of 'stolbur' (1 to 9 per cent.); and planting in denser stands than the standard reduced infection from 28 to 17 per cent. and increased the yield. In the field 'stolbur' infection usually follows tobacco mosaic, attacking more severely plants infected with mosaic at early stages of growth than those infected later.

P. I. Dvornikov's (pp. 269–271) observations at the Moldavian Experiment Station showed that tomato plants most liable to become infected by 'stolbur' are those with few leaves and horizontally-grown stems which are very exposed to the sun's rays. The temperature above the soil near the base of such plants is about 70°, whereas near upright-growing plants which provide shade for themselves it was not above 30°. During 1939 it was observed that upright varieties showed only 4 to 6 per cent. 'stolbur', those inclined to lodge but with rich foliage (Market's Marvel, John Baer) 17 to 19 per cent., and those with widely spaced leaves, such as Break-o'-Day and Budennovka, 25 and 34 per cent., respectively. In the 1938 and 1939 tests plots with a nutritional area [per plant] of 100×20 cm. had 3·4 and 17 per cent. 'stolbur' as against 17·7 and 41 per cent., respectively, in plots with one of 100×70 cm. Earthing-up of tomato bushes (in a 100×100 cm. series) resulted in 19·2 per cent. infection as compared with 61·5 in the control plot; covering the base of the plant with white paper (in a 100×40 cm. series) gave 8·2 per cent. infection as against 18·2 in the control.

A. I. Serebryakov (pp. 272–277) describes 'stolbur' as the most widely spread and harmful disease of tomato in the southern U.S.S.R. In the Krasnodar region, where it is only moderately prevalent, the disease caused losses of at least 5 tons per ha. Infection coincides with the beginning of the fruiting stage of the host plant. In the Krasnodar and Rostov regions four different types of 'stolbur' expression were observed: (1) the leaves are characteristically elongated and small, new shoots later become blue-violet, often with a yellow tinge, no fruit or only a few orange-coloured ones are formed, and the plants dry off long before the end of the vegetative period; (2) leaves show throughout the season a mosaic pattern without change of colour, a few fruits are formed, sometimes proliferation of

branches occurs, and the plants dry off only at the end of the season at the same time as healthy ones; (3) a rare form is characterized by a twisting of the stem of 180°, drooping and spiral twisting of leaves, giving the plant a 'weeping' appearance, and a mosaic type of colouring of the whole plant; and (4) plants have the mosaic colouring without pronounced proliferation of branches, but all trusses are very branched and bear many undeveloped buds. Seeds harvested from 'stolbur'-infected plants were very flat with only about 20 per cent. germination, giving rise to very weak, but otherwise normal seedlings; the subsequent development of 'stolbur' in these seedlings did not differ significantly from that in other plots, indicating that the disease, though inducing very poor-quality seed, is not seed-transmitted. Of the various tomato varieties tested those belonging to the *validum* group (bushy forms) showed most resistance to 'stolbur': in 1939 Kuban (hybrid 252) showed 14 to 19 per cent. infection as compared with 50 to 80 per cent. in the Break-o'-Day, Marglobe, and Juwel 4.

Mme O. N. Vertogradova (pp. 278–285) reports that a survey of 18 farms in the Saratov region during 1937 revealed 'stolbur' to be present in all, affecting 2·2 to 68·1 per cent. (usually 20 to 60 per cent.) of tomato plants, generally with a medium degree of severity, although severe infection was detected in 17·6 to 30 per cent. In the Stalingrad region 'stolbur' was also generally present, affecting 14·5 to 89 per cent. of the plants (usually 40 to 89 per cent.), the prevalent degree of infection being medium and severe. In the [former] Republic of Volga Germans 'stolbur' was almost universally present, with 5 to 70 per cent. infection and a medium degree of severity. Experiments in the Saratov district showed that a loss of 97 per cent. of the yield corresponds to the severe degree of infection, one of 64·4 to the medium, and one of 17·3 to the slight. Losses amounting to 61·08 per cent. of the yield occurred on a farm with 68·1 per cent. infection. The percentage of woody fruits in the variety Budennovka, which had shown 45 per cent. infection, amounted to 12·18. In the Stalingrad district up to 60 per cent. of the harvested fruits were diseased. A planting of the variety Budennovka with 62 per cent. infection yielded 37·83 per cent. woody fruits. Observations in the lower Volga region lend no support to the opinion of workers elsewhere that 'stolbur' is connected with poor water supply, as plantings situated in moist localities were found to be severely affected, while some in the dry steppe were almost free from disease; where watering was applied, 'stolbur' developed most severely in the wake of the sprayer; and finally, healthy or only slightly affected plants were found growing on high-lying fields receiving no watering. In monoculture, tomatoes suffered more from 'stolbur' than in crop rotation. In varietal trials the highest resistance (from 1 to 5 per cent. infection only) was displayed by the bushy varieties Alpatyeva and Planovoy, Best of All, John Baer, and Hybrid 252. Aucuba mosaic of tomato was found on only one farm in the Stalingrad district.

Mme E. V. Shatova (pp. 286–293) gives the results of chemical tests in the control of tobacco mosaic conducted during 1939 at the Virus Laboratory of the Pan-Soviet Institute of Plant Protection. Complete inactivation of the virus *in vitro* was accomplished by adding 1 per cent. Bordeaux mixture to the sap of mosaic-diseased leaves of Trapezond 703 tobacco (in proportions 1 to 1 or 1 to 2) and storing the mixture for 2 hours at a temperature of 20° to 22°. Similar treatment of the diseased sap with 2 per cent. lime-sulphur or 1 per cent. barium fluosilicate gave only partial inactivation. The same three chemicals were used for spraying tomatoes as a means of protection against mechanical infection. seedlings were sprayed the day before the first transplantation (in the greenhouse) and then artificially infected with the virus of tobacco mosaic by pressing first a diseased leaf between two fingers and then healthy ones, wounding only the hairs. After 21 days seedlings sprayed with (1) barium fluosilicate showed 77 per cent. mosaic, (2) lime-sulphur, 79 per cent., and (3) Bordeaux mixture 89 per cent.,

while unsprayed infected seedlings had 97·4 per cent. The same day healthy plants of all series (and other healthy ones of the same age to make up the numbers) were planted out into the open after being again sprayed and infected as before: 12 days later series (1), (2), and (3) showed 79·4, 75·6, and 81·4 per cent. healthy plants, respectively, as against 11·1 per cent. in the unsprayed infected control. The lower percentage of healthy plants in series (1) is ascribed to the difficulty of spraying seedlings in flats thoroughly. The yields of the three sprayed series and of the unsprayed infected control were 91·8, 82·9, 77·2, and 43·9 per cent., respectively, of the unsprayed healthy control. In experiments with tomato and tobacco workers first touched a diseased leaf and then submerged their hands in a solution of one of the three above-mentioned chemicals for 5 to 10 seconds before transplanting each plant; in the control series, the hands were washed in water. As a result, 100 per cent. of tobacco and 96 of tomato seedlings in the control series became infected as against 18, 22, and 16 per cent., respectively, in the three disinfectant series with tobacco, and 30, 34, and 20 per cent., respectively, with tomato. None of the chemicals was harmful to the skin; a slight yellow discoloration produced by lime-sulphur disappeared after two thorough washes. It was noticed that diseased tomato plants in the three series in which chemicals were used, although exhibiting mosaic symptoms, developed almost as well as healthy ones.

E. M. Eristavi (pp. 294–308) gives a list of virus diseases recorded on 39 genera of plants in Georgia during 1939; new records are a ring-spot type of disease on *Phaseolus multiflorus*, pea mosaic, a rosette disease of groundnut (resembling that caused by *Arachis* virus 1), a mosaic of *Pistacia mustica*, spotted wilt of tomato (causing up to 58·17 per cent. infection and inflicting serious losses), streak and aucuba mosaic on tomato, 'stolbur' on chilli (up to 50 per cent. infection), and mosaic of *Physalis alkekengi*, *Solanum persicum*, *Hyoscyamus niger*, *Petunia* sp., and *Datura stramonium*, which also showed a necrotic ring spot of *Lycopersicum* virus 3 type.

Mme A. Sladkomedova (pp. 309–315) describes a new disease of potato, of unknown origin, in the Kharkov region, where it has been on the increase since 1935 (the percentage of infection rose from 6·1 in 1936 to 62·6 in 1939). The most stable symptom of the disease is the round shape of the leaves; the diseased plants are usually dwarfed and later in the season the leaves become slightly wrinkled; the tubers set abnormally late if at all and remain very small. Sometimes the symptoms are restricted to one part, usually the top, of the plant. Frequently, the symptoms become masked and the plant acquires a normal appearance. The yield of diseased plants is reduced by from 53 to 91·3 per cent. that of the healthy. The disease was found to be transmitted through mother tubers. No fungi or bacteria were associated with the disease.

Mme A. N. Mamontova (pp. 316–320) successfully applied the serological method for the identification of leaf roll of potato in seed material. In the resting tuber the virus was found to be concentrated in the centre, mainly in the youngest part of the tuber; in the sprouting tuber the virus is evenly distributed throughout.

Plant diseases. Notes contributed by the Biological Branch.—*Agric. Gaz. N.S.W.*, lv, 1, pp. 16–20, 6 figs., 1944.

In New South Wales the most serious seed-borne tomato disease is bacterial canker (*Aplanobacter* [*Corynebacterium*] *michiganense*) [*R.A.M.*, xxii, pp. 11, 420]. All commercial varieties are susceptible, and losses of 80 per cent. or more are often experienced in crops grown from infected seed. As the organism can live over in the soil and will infect the crop planted in the following season, losses may be very heavy indeed. Seed should be saved only from crops free from the disease. Seed which, it is thought, may be carrying infection, should be soaked for 24 hours

in 0·6 per cent. acetic acid and thoroughly dried. This treatment can be effected at any time before sowing. It does not impair germination or keeping quality. Affected crop refuse should be collected and burnt, and the land should not be planted to tomatoes again for at least three years. The site of the seed-beds should be changed annually.

Oats are affected locally both by loose smut (*Ustilago avenae*) and covered smut (*U. levis*) [*U. kolleri*], while intermediate types and distinct strains of these fungi are also present [*R.A.M.*, xxi, p. 124]. Locally, loose smut is the most common form of the disease. The Lampton variety is highly resistant to smut, while the Belar, Buddah, Gidgee, Guyra, Mulga, and Sunrise varieties are moderately resistant, and the Algerian, Burke, Fulghum, and White Tartarian are susceptible. Seed of susceptible and moderately susceptible varieties not obtained from crops known to be free from smut should be treated with agrosan or ceresan dust (2 oz. per bush.).

Osborn (E. M.). **On the occurrence of antibacterial substances in green plants.**—*Brit. J. exp. Path.*, xxix, pp. 227–231, 1943.

Of approximately 2,300 species of plants belonging to 166 families tested against *Staphylococcus aureus* and *Bacterium coli*, 63 genera belonging to 28 families were found to contain substances inhibitive to the growth of one or both test organisms. Only two plants were specific against *Bact. coli*. Extracts from plants of the same family showed a similar specificity and potency, suggesting that similar types of anti-bacterial substances occur throughout the family. The active substances were in some cases distributed throughout the plant, and in others restricted to one part of it. Drying resulted in a loss of inhibitory power in some plants, while in others it was still active after a year. Certain well-known drug plants, such as *Atropa*, *Datura*, and *Digitalis*, showed no inhibitory power under conditions of this experiment.

Levine (M.). **Formative influence of carcinogenic substances.**—*Cold Harb. Symp. quant. Biol.*, x, pp. 70–78, 1942.

Included in this critical survey of the literature on the carcinogenic action of chemical substances are references to the development of crown gall (*Pseudomonas* [*Bacterium*] *tumefaciens*) in plants in response to the application, e.g., of coal tar and scarlet red and other azo compounds. A number of the studies under discussion have been noticed in this *Review* from time to time. The results to date of the experiments on plants are interpreted as indicating that tumour formation is a function of the host rather than an effect of the chemical applied. The slight overgrowths induced by some carcinogens are somewhat analogous to benign growths, but more closely resemble the protective scar tissues or granulomata of man and animals [cf. *R.A.M.*, xxiii, p. 8].

Riceman (D. S.) & Anderson (A. J.). **The symptoms and effects of copper deficiency in cereals and pasture plants in South Australia.**—*J. Dep. Agric. S. Aust.*, xlvii, 2, pp. 64–72, 13 figs., 1943.

Full descriptions are given of the effects of copper deficiency on cereals and grasses in South Australia [cf. *R.A.M.*, xxiii, p. 148]. Wither-tip, the severe form on oats, appears during hot weather in September. The leaves are limp, and the young shoots and leaf tips wither and turn white, at the same time being sharply reflexed. The last-formed leaves are primarily affected, but in severe cases all the leaves show the condition. The margins commonly show a pale green or yellow colour. Severely affected plants rarely produce heads. New tillers appear throughout the season, and an affected crop may remain green and produce tillers long after normal crops have ripened off, these secondary tillers also developing wither-tip. If produced, the heads are white and empty. A milder form occurs in which

wither-tip lesions develop on some leaves only, and pale margins are less common. The normal number of heads may be produced, but these are white and empty, or very poorly filled. There is some secondary tiller formation. In addition, oats are widely affected by an obscure form of copper deficiency in the south-eastern areas, in which the condition may be detected only by experimental means.

A comparison of severely affected wheat and oat plants shows that wheat usually suffers more severely than oats, developing a progressive die-back of the leaves and shoots, without secondary tillering. Wither-tip is not found in wheat. The affected parts of the wheat leaf turn brown. The sharp collapse of the leaf observed in wheat is not found in oats. In wheat, the older leaves are affected first. Barley appears to be less susceptible than oats. The leaf lesions are similar to those on oats, but are less pronounced, and there is more yellowing and less bleaching. No continued or excessive tillering occurs, and badly affected plants die before reaching maturity. Rye has shown no reponse to copper treatments locally, and has given a satisfactory crop without treatment, even in affected areas. No disease symptoms were observed in the field. Copper deficiency symptoms are seldom seen on plants comprising the natural pastures on soils very deficient in copper, but susceptible species are unable to compete with resistant types.

When copper deficiency is suspected, simple trials with copper-superphosphate mixtures should be made. Tests should also be carried out to ascertain the most productive varieties for each affected area. In the coastal sandy areas seriously deficient in copper and zinc, simple top-dressing of the natural grasses with copper-zinc superphosphate is unlikely to produce any response; in these localities, suitable species must be sown with the superphosphate mixture.

Riceman (D. S.) & Anderson (A. J.). **Copper and zinc deficiency in pasture and crops in South Australia.**—*J. Dep. Agric. S. Aust.*, xlvii, 1, pp. 16–29, 15 figs., 1 map, 1943.

In this paper the authors discuss the widespread distribution of copper and zinc deficiency in South Australian soils [see preceding abstract] and make recommendations, based on seven years' experiments, for appropriate and effective treatment which will enable good cereal crops to be grown and permit the establishment of sown pastures and lucerne.

Most of the area concerned is only slightly affected. Direct trials on indicator cereals, such as oats or wheat, offer a simple method of detection of deficiencies, and growers are advised to carry out their own trials by sowing a long drill-row in the usual manner with superphosphate containing 14 lb. copper sulphate per bag, and comparing the effect on the grain yield from this strip with the yield from an adjacent strip sown with superphosphate only. Similar sowings of different legumes with and without zinc and copper will indicate the presence or absence of the deficiency and show what species is best adapted to the environment.

White (N. H.). **Physiological studies on the fungus Ophiobolus graminis Sacc. 2. Carbon and nitrogen requirements.**—*J. Coun. sci. industr. Res. Aust.*, xvi, 4, pp. 234–244, 2 graphs, 1943.

Further studies on *Ophiobolus graminis* [*R.A.M.*, xx, p. 522] demonstrated that it can utilize a wide range of compounds as sources of carbon and nitrogen for respiration (estimated as oxygen uptake) and assimilation (dry weight of mycelium after ten days' growth). Assimilation was greatest with carbon as carbohydrates and nitrogen as asparagin or peptone. Some compounds which gave poor assimilation were good respiratory substrates. Differences were found in the assimilability of compounds, and when carbon and nitrogen were present in optimal amounts these differences were due to anabolite efficiency values of the compounds, which conditioned the growth rate rather than the maximal amount of growth of

the fungus. This was the third factor (the other two, biotin and thiamin, being found in the earlier work) conditioning growth in synthetic solutions. The efficiency values were optimal for growth when nitrogen was supplied as a mixture of amino acids or peptone and carbon as glucose at optimal concentration.

The optimal concentration for nitrogen, as potassium nitrate, ammonium nitrate, glycine, or asparagin, was 200 mg. per l., when the carbon source was equivalent to 2 per cent. glucose, while the concentrations were 200 mg. per l. and 1 per cent. when nitrogen was supplied as a mixture of amino acids or peptone.

The growth phases on all forms of nitrogen resembled those of bacteria, and induced characteristic changes in the substrate.

Ammonia was produced in the substrate when organic nitrogen compounds were the sole source of carbon for respiration and assimilation, and again during the autocatalytic phase of growth. In both cases ammonia production appeared to be due to deamination processes.

Dastur (J. F.). **Notes on some fungi isolated from 'black point' affected Wheat kernels in the Central Provinces.** *Indian J. agric. Sci.*, xii, 5, pp. 731–742, 1 pl., 8 figs., 1942.

The following fungi were isolated from wheat kernels affected by 'black point' in the Central Provinces [*R.A.M.*, xv, p. 433]: *Cochliobolus tritici* n.sp., *Helminthosporium* spp. A and B, *Pseudophoma* sp., *Nigrospora sphaerica*, *Rhizoctonia* sp., and *Sclerotium rolfsii*.

C. tritici is characterized by scattered or gregarious, brownish to black, pseudoparenchymatous flask-shaped perithecia, 220 to 597 by 172 to 406 μ, with or without cylindrical, ostiolar beaks, 53 to 236 by 53 to 124 μ ; cylindrical or clavate, straight or slightly curved, shortly stipitate or sessile, hyaline, thin-walled asci, 80 to 228 by 13 to 34 μ, containing eight helicoid, flagelliform or filiform, 4- to 12-septate, hyaline spores, obtusely pointed at the apex and tapering towards the base, 125·4 to 301·6 by 3·8 to 7·6 μ; numerous hyaline, septate, sometimes dichotomously branched paraphyses, 1·6 μ in width; and straight to slightly curved elliptical, 5- to 9-septate conidia, with broadly rounded ends, firm, light brown to honey-coloured walls, and a basal scar, 45·6 to 83·6 by 11·4 to 15·2 μ.

H. A produced two kinds of conidiophores, one arising directly from the mycelium in the cells of the host tissue, and the other from the thin layer of aerial mycelium on the exterior of the pericarp. In the former type the base is swollen or bulbous, while in the latter the conidiophore is a prolongation of a hyphal branch, and its inception is marked by a slight thickening and colouring of the terminal cell of the hypha. The 3- to 6-septate conidiophores borne on the pericarp measure 41 to 243 μ up to the first scar and their bulbous ends 5·5 to 11 μ in width. The development of the obpiriform, obovate spearhead-shaped, or elongated-elliptical, straight but sometimes compressed and distorted, 3- to 7-septate, dark brown or honey-coloured, basally pale or hyaline conidia, 45·6 to 91 by 18·7 to 30 (average 52 to 78 by 18·7 to 30·4) μ, is typical of the genus.

H. B is characterized by a very sparse production of conidiophores and conidia. The former are simple, light to dark honey-coloured, 3- to 5-septate and measure 23 to 53·2 by 2 to 3·5 μ up to the first scar, and the latter, numbering two to six on each conidiophore, which they resemble in colour, are elliptical, uniformly triseptate, 18·75 to 30 by 7·5 to 11·25 μ.

P. sp. produces subepidermal, coriaceous to carbonaceous, piriform or subglobose perithecia, provided with a short ostiolate beak, 152 to 228 by 38 to 53 μ; and hyaline, ellipitical or ovoid, unicellular conidia, 5 to 6·7 by 1·7 to 3 μ, escaping through the ostiole in long tendrils.

Inoculation experiments with *C. tritici*, the two *H.* spp., *P.* sp., and *S. rolfsii* gave positive results.

In the few cases in which the kernels yielded more than one organism, the mixtures included *Aspergillus*, *Penicillium*, *Mucor*, *Fusarium*, *Chaetomium*, *Alternaria*, and *Cladosporium* spp., singly or combined.

HUMPHREY (H. B.) & DUFRÉNOY (J.). **Host-parasite relationship between the Oat plant (Avena spp.) and crown rust (Puccinia coronata).** —*Phyptopathology*, xxxiv, 1, pp. 21–40, 6 figs., 1944.

In November and December, 1942, and in January and February, 1943, oats seedlings of the Bond, Victoria, Rainbow, Markton, Richland, and Bond × D 69 seedlings were inoculated in the greenhouse at Louisiana State University with the uredospores of physiologic race 1 of *Puccinia coronata*, originating at Beltsville, Maryland. The establishment of the parasitic relationship between the leaf cells of the host and the invading hyphae of the rust was shown to depend on the release of phosphorus compounds by the former for the utilization of the latter. Cytochemical examination of the affected tissues revealed changes that are interpreted as secretion phenomena and appear to correspond with those proceeding in either plant or animal cells in response to the physical, chemical, or pathological stimulus of a parasite or other pathogenic agent. The excretion of phosphorus into the intercellular spaces by cells which would normally retain this element intact is accompanied by an internal secretion within the vacuolar solution, resulting in the 'coacervation' [*R.A.M.*, xxi, p. 536] of phenolic compounds, especially pyridoxin. These indophenol blue-forming phenolic compounds are most abundant in the vacuoles of the guard cells and of the long epidermal cells in line with the stomata. The 'coacervation' of phenolic compounds appears to be correlated with the dispersion of the nucleotids or phosphoproteids in the cell and with the resultant decompensation of respiration. The latter process may assume varying degrees of severity, a mild form permitting the survival of the host cells, while severe damage rapidly proves lethal to the plant, which reacts by the development of the necrotic lesions characteristic of hypersensibility.

WEBBER (H. J.). **A doença da 'tristeza' do porta-enxerto de Laranjeira azeda.** [The 'root rot' of Bitter Orange stocks.] —*Biológico*, ix, 10, pp. 345–355, 1943.

The author traces the history of the form of root rot known as 'tristeza' affecting sweet oranges and other species of citrus grafted on bitter orange stocks, and critically discusses the various theories advanced in explanation of the disease, which was first recognized in South Africa about 1910 and subsequently reported from Java (1928), Argentina (1931 or thereabouts) [*R.A.M.*, xx, p. 400; xxi, p. 485], and Brazil (1937). In the last-named country it has been studied by S. Moreira (*Biológico*, viii, pp. 269–272, 1942). Of the possible causes of the trouble, that of latent virus infection appears to be the only one meriting further investigation. Strong evidence in favour of the infectious nature of the disease is afforded by its spread from country to country and province to province.

In an explanatory note on pp. 360–361 on Webber's attribution of the root rot to a virus occurring in a masked form in the bitter orange stock and producing symptoms only on the sweet scion, A. A. Bitancourt points out that this theory was first advanced by himself, H. S. Fawcett, and H. A. Speroni, following a tour of the affected regions in 1937.

SILBERSCHMIDT (K.). **Sôbre a provável causa da 'tristeza' das Laranjeiras.** [On the probable cause of 'root rot' of Oranges.] —*Biológico*, ix, 11, pp. 371–378, 1943.

The writer does not find Webber's virus theory of the origin of sweet orange root rot on bitter orange stocks [see preceding abstract] altogether convincing, weighty objections to its acceptance including the absence of authenticated reports of an insect vector; the nature of the symptoms, which are more suggestive of

chronic decline than acute infection; and the restoration to health both of stock and scion by separation of the two components. In any case, the evidence in support of virus agency is not sufficiently strong to justify the abandonment of other avenues of exploration.

Singh (L.) & Hamid (A.). **The cold storage of fruits in the Punjab. I. Citrus fruits : Malta (Citrus sinensis) and Sangtra (C. nobilis).** *Indian J. agric. Sci.*, xii, 5, pp. 757–778, 1 pl., 1 diag., 3 graphs, 1942.

In connexion with studies on the cold storage of oranges at Lyallpur, Punjab, in 1938–9, chill spotting and deterioration in flavour were the principal defects at the low temperature of 29° to 32° F., whereas at the higher ranges (36° to 39° and 40° to 43°) fungal infection was the chief source of wastage, mostly associated with *Penicillium digitatum* and *P. italicum*. A species of *Alternaria* was isolated from the internal segments of the pulp near the stem end of a few fruits, while in 1939 *Colletotrichum gloeosporioides* was also implicated in the causation of stem-end rot.

Sokoloff (V. P.), Klotz (L. J.), & Turrell (F. M.). **Physiological disturbance in leaf causes mesophyll collapse.** *Citrus Leaves*, xxiii, 3, pp. 8–10, 1943. [Abs. in *Chem. Abstr.*, xxxvii, 19, pp. 5760–5761, 1943.]

Chemical analyses of the collapsed mesophyll frequently observed in the foliage of citrus trees in the coastal regions of various localities [of southern California: *R.A.M.*, xxii, p. 14] revealed a lack of balance in the distribution of calcium, magnesium, potassium, and sodium ions between the aqueous and solid phases of the leaf tissue. Such conditions may arise from the replacement of calcium in calcium pectate by sodium or potassium, resulting in the formation in the tissue framework of a compound devoid of the requisite water-regulating properties. The abnormal condition was experimentally induced by waterlogging three-year-old orange seedlings in the presence of magnesium sulphate.

Pine (L.). **A hitherto unreported disease of the Washington Palm.** *Phytopathology*, xxxiii, 12, pp. 1201–1204, 1 fig., 1943.

Phytomonas washingtoniae, the agent of a water-soaked leaf-spotting of the leaf blades and petioles of *Washingtonia filifera*, first observed at Tucson, Arizona, in the late autumn of 1942, is a non-spore-forming, Gram-negative, motile rod, the poles furnished with one to three flagella, 1·6 to 0·7 μ, occurring singly or in chains of three to four, and producing on crystal violet agar smooth, convex, glistening white to cream-coloured, butyrous, circular colonies, with entire margins, reaching $1\frac{1}{2}$ to 2 mm. in diameter after ten days at 20° C. The thermal death point of the organism is 47° to 48° (ten minutes in bouillon). Gelatine is liquefied and milk peptonized, but starch is not hydrolysed, neither is indol produced, nitrate reduced, nor milk coagulated. Glucose, fructose, and l-arabinose are utilized and acidified in 24 hours, galactose and xylose in 48.

The lesions, 10 to 15 mm. in length, penetrate the entire thickness of the leaves, but in the fleshy petiole they are limited to the parenchyma tissue. Entry into the host is effected by way of the stomata. The disease flourishes under the humid, cool conditions of late autumn and winter. Since the foliage is merely blemished and not destroyed, the disease is economically important only in so far as it lowers the ornamental value of the palm.

Dunlap (A. A.). **Inhibition of Phymatotrichum sclerotia formation by sulphur autoclaved with soil.** *Phytopathology*, xxxiii, 12, pp. 1205–1208, 1 fig., 1943.

When thoroughly mixed with the soil and autoclaved, 325-mesh dusting sulphur, at the rate of one part per 1,000 of air-dry black Houston clay soil, totally inhibited

the formation of sclerotia by the agent of cotton root rot, *Phymatotrichum omnivorum*, with no apparent effect on mycelial growth. At 1 : 2,000 the same mixture permitted only a trace of sclerotial growth, which proceeded unchecked, however, in the presence of a 1: 8,000 concentration. The repressive action of the sulphur-soil mixture is possibly due to the formation of a toxic compound on autoclaving.

YOUNG (P. A.). **Cottons resistant to wilt and root knot and the effect of potash fertilizer in East Texas.**—*Bull. Tex. agric. Exp. Sta.* 627, 26 pp., 6 figs., 1943.

In the sandy-loam fields of East Texas cotton yields are often seriously decreased by wilt (*Fusarium vasinfectum*), nematode root knot (*Heterodera marioni*), and potash hunger [*R.A.M.*, xxi, pp. 74, 450]. Two or more of these troubles may be associated in the same field, and these factors in combination present some exceptionally difficult problems.

In variety-fertilizer tests from 1937 to 1939, using fertilizer at 400 lb. per acre in 1937 and 600 lb. subsequently, adequate wilt resistance with large yields of good-staple cotton was shown by the following varieties: Clevewilt, Cook 144-68, Dixie Triumph 25-12, Dixie 14-5 str. 2, Dixie Triumph 55-85, Miller 610, Rowden 2088, Coker 4-in-1, and Deltapine 12. The rows without potash fertilizer (6-8-0) usually showed marked potash deficiency, which was absent from those with 6-8-8 fertilizer, and mild and uncommon in those with 6-8-4. In nine main varieties the use of fertilizers containing 4 per cent. potash gave increases of 18 to 53 (average 28·5) per cent. in average yield, as compared with 6-8-0 fertilizer. Increasing the potash to 8 per cent. gave additional increases of 3 to 24 (average 10·5) per cent. in the three-year-average yields. The average yield of all nine varieties for three years was 677 lb. seed cotton per acre with 6-8-0 fertilizer, 870 lb. with 6-8-4, and 948 lb. with 6-8-8. It was further calculated that 45·7 per cent. of the wilt present was associated with 6-8-0 fertilizer, 33·3 per cent. with 6-8-4, and 21·3 per cent. with 6-8-8. The 4 per cent. potash in the fertilizer decreased wilt by 12·7 per cent., and the 8 per cent. potash by a further 11·7 per cent. The potash fertilizer decreased the percentage of wilted plants in 24 of 27 tests and in eight of nine varieties. Clevewilt showed the strongest wilt resistance, and was the only variety that did not respond to potash.

In 1941 Coker 100 W.R. str. 39-5, Coker 4-in-1, Miller 610, and Tifton Dixie Triumph all showed strong wilt resistance and gave large yields of good-staple cotton, the 6-8-8 fertilizer (500 lb. per acre) apparently minimizing wilt as compared with previous seasons.

Taking the six years' results as a whole, the author found that the following varieties (arranged in decreasing order of likely value) were highly wilt-resistant: Coker 4-in-1, Coker 100 Wilt Resistant str. 39-5, Delta Dixie W.R. str. 2, Tifton Dixie Triumph, Dixie Triumph 25-12, Dixie 14-5 str. 2, Delfos 425, Miller 610, Delta-pine 12, and Stonewilt. In addition, Coker 4-in-1, Coker 100 W.R. str. 39-5, and three strains of Dixie varieties were resistant to wilt and root knot together. Miller 610 lost much of its wilt resistance in the presence of root knot.

It is concluded that farmers can prevent wilt and root knot from becoming limiting factors in cotton production by growing only those varieties that are resistant to both, using high-potash balanced fertilizers, and rotating cotton with *Crotalaria spectabilis* and sorghum.

DASTUR (R. H.) & SINGH (M.). **Studies in the periodic partial failures of the Punjab-American Cottons in the Punjab. VII. Amelioration of tirak on soils with saline subsoils (sandy loams).**—*Indian J. agric. Sci.*, xii, 5, pp. 679-695, 2 pl., 1942.

Deferred (June) sowings and additional applications of water from the flowering stage onwards improved the condition of Punjab-American cotton plants suffering

from 'tirak' (bad opening of the bolls) on sandy loam soils in experiments carried out at the Lyallpur Agricultural Farm in 1938–9, 1939–40, and 1940–1 [*R.A.M.*, xxii, p. 204].

Varada Rajan (B. S.). **A mildew on Jute.**—*Sci. & Cult.*, ix, 8, pp. 351–352, 1 fig., 1944.

In November, 1942, jute specially grown for crossing experiments at the Jute Agricultural Research Laboratories, Tejgaon, Dacca, India, was attacked by a mildew (*Oidium* sp.), which persisted up to the end of February, the coalescent lesions covering the entire upper lamina and in severe cases also involving the lower leaf blades. The petioles, stipules, axillary leaves, the entire stem, flower-bearing branches, and capsules ultimately contracted the disease, which was more prominent on *Corchorus capsularis* than on *C. olitorius*. In the following August the mildew was observed on the main crop raised during the monsoon, but in this case the symptoms were inconspicuous, consisting merely of a few greyish or whitish patches on the stem and very sparse foliar infections.

The hyaline, septate hyphae of the fungus range from 2·9 to 7·8 μ in diameter, the erect, stout or slender conidiophores from 70 to 140 μ in length (average 94·5 μ), and the hyaline, elliptical, smooth, unicellular conidia, from 21·5 to 54·2 by 13 to 23·3 (33 by 17·4) μ, often in chains of two or more.

This is apparently the first record of a mildew on jute.

Vanterpool (T. C.). **Studies on Crown and Royal Flax in Flax-sick soil. I. The determination of Crown and Royal seed samples by growth in Flax-sick soil. —II. Comparative mortality response of Crown and Royal Flax in two different Flax-sick soils.**—*Sci. Agric.*, xxiv, 6, pp. 259–267, 3 figs.; pp. 268–270, 1 fig., 1944.

As it has been generally recommended that the cultivation of the Crown variety of flax should be discontinued in Saskatchewan because of its susceptibility to *Fusarium lini*, and that the moderately resistant Royal should be grown instead, experiments were carried out to devise a quick and reliable means of ascertaining the identity of undetermined seed stocks of these varieties, which cannot be separated visually.

A comparison was made of the percentages of wilt (total plant mortality) in 96 such samples grown in soil in the greenhouse, and 68 samples in both the greenhouse and the field, the University strains of the two varieties serving as controls. With few exceptions the incidence of wilt in each variety was about 13 per cent. higher in the field than that in the greenhouse, but in every instance the varietal determinations in the greenhouse and in the field were in agreement. It is concluded that for the time being the greenhouse method can be used without field test.

There was evidence that five of the 96 samples tested were mixtures of Crown and Royal; that mixing can occur is shown by admixtures of Bison and Redwing seeds in samples of Crown and Royal, and great care should be taken by producers to prevent Royal stocks being contaminated with Crown.

In the second paper the author states that rather higher percentages of wilt (*F. lini*) have been reported on Royal flax grown in wilt nurseries in eastern Canada and the northern areas of the United States than have been recorded in the wilt nursery at Saskatoon, Saskatchewan, and points out that under certain conditions other fungi, such as *Rhizoctonia* [*Corticium*] *solani*, *Pythium debaryanum* [*R.A.M.*, xv, p. 440], and *F.* spp. also contribute to plant mortality in such soils. He describes an experiment in which the highly wilt-susceptible Crown variety and the moderately resistant Royal were grown under greenhouse conditions in wilt-infested soil from Ottawa and from two nurseries at Saskatoon. Royal flax

showed only moderate survival, with 36 per cent. wilt (as expressed in post-emergence mortality) in the Ottawa soil, and high survival, with only 10 to 12 per cent. wilt, in the Saskatoon soils. Crown flax showed fair survival, with 66 per cent. wilt, in the Ottawa soil, and poor survival, with 97 to 99 per cent. wilt, in the Saskatoon soils.

This result indicates that the strains or species of pathogenic fungi in the Ottawa soil are more virulent on Royal flax and less virulent on Crown than are the strains or species of fungi in the Saskatoon soils. In all the flax-sick soils Crown flax showed a definite progressive plant mortality up to the final survival count; Royal showed a moderate progressive mortality in the Ottawa soil, but only a slight increase in mortality after the first count in the Saskatoon soils. This may indicate that the killing of Royal in the early seedling stage in the Saskatoon soils is chiefly of the damping-off type (*P.* spp. and *C. solani*), whereas in the Ottawa soils some other fungus is responsible for the later killing of Royal.

MILLIKAN (C. R.). **'Withertop' (calcium deficiency) disease in Flax.**—*J. Dep. Agric. Vict.*, xlii, 2, pp. 79–91, 8 figs., 2 graphs, 1 map, 1944.

Flax in Victoria is affected by a condition referred to as 'withertop', which, since it was first observed in 1939, has caused severe losses. The damage sustained has varied from a trace to 100 per cent., over an area of up to 100 acres at a time. In the Colac district in 1941, 10 per cent. of the area under flax was not harvested because of the disease. The general loss in Victoria probably amounts to about 1 per cent.

The disease appears at any time from mid-September onwards. The crops do not become affected until they are 12 to 15 in. high and are making rapid growth. As a rule, very little withertop develops after about the middle of October. In one instance a very early crop of Liral Crown showed the condition towards the end of August. Prevalence is usually greater in early- than in late-sown crops.

Symptoms develop in a few hours. A sharp bend occurs 2 to 4 in. below the tip of the plant. At the point of the bend the stem soon loses rigidity, and the top of the plant hangs down vertically. When bending first occurs, there is no sign of browning at the bend or above it. Necrosis, however, sets in at the point of the bend, and spreads rapidly until the whole of the bent-over portion is dead. Affected patches in a crop appear brown when seen from a distance. The stem below the bend remains apparently normal. The diseased plants may occur in well-defined patches where the ground is waterlogged, or a whole crop may be affected. A few days after the browning at the top of the stem has started, the plant usually sends out secondary shoots from the axils of the leaves immediately below the affected top. When drier weather sets in, these shoots develop normally, but where the soil again becomes waterlogged, this second growth may also develop the condition. If withertop occurs some time after bud formation, only the individual flower stalks may collapse. A very mild form of the disease, involving only a necrosis of the flower sepals from the tips downwards, has also been observed. Severely affected plants produce short fibre of low value. Where second growth has occurred, the fibre is generally broken during the scutching process at the point where it joins the main stem, two fibres of much less than standard length being produced.

Mineral deficiency tests with sand and water cultures showed that whereas mild calcium deficiency symptoms were identical with those of withertop in the field, the symptoms of phosphorus, nitrogen, magnesium, potassium, zinc, and copper were quite different. Typical withertop developed in flax plants grown in a complete nutrient solution until they had reached a height of 15 in. and then removed to a calcium-deficient solution. Chemical analyses showed that withertop plants had a much lower calcium concentration than healthy plants from the same crop.

In pot tests incidence was increased by waterlogging. The effect appears to be greatest when the waterlogging occurs about the time the plant is 12 to 15 in. high and rapidly lengthening. Before this stage was reached flax plants tolerated long periods of waterlogging. In such cases growth was retarded. After ten weeks' waterlogging some plants developed a 'tip necrosis' apparently identical with symptoms of severe calcium deficiency.

Pot experiments demonstrated that the disease was controlled by an application of lime or gypsum at rates varying from 1 to 4 tons per acre. In a field test as little as 3 cwt. slaked lime per acre gave appreciable reduction in withertop, while with 4 tons limestone per acre the disease was completely absent. All the straw from the unlimed areas was worthless for fibre, while the limed plants produced a heavy yield of high-quality straw.

Tobler (F.). **Flachsrost und Bastfaser.** [Flax rust and harl fibre.] -*Faserforsch.*, xv, pp. 132–135, 1941. [Abs. in *Zbl. Bakt.*, Abt. 2, cvi, 1–4, p. 74, 1943.]

The anatomical study of harl fibres derived from flax infected by rust [*Melampsora lini*] revealed varietal differences in the nature of the attack and its effect on the firmness of the material and its suitability for retting. Thus, the primary tissues of the Karnobat variety, designated by Straib as 'virtually free from infection' [*R.A.M.*, xxi, p. 490], contained an abundance of brown mycelium, which was absent from the fibres. The latter, on the other hand, sustained heavy damage in the least resistant variety, Svalöf Hercules. It is evident, therefore, that the action of the rust on the fibres, as well as the external symptoms of the disease, must be taken into account in assessing the extent of the injury from this source.

Garber (K.). **Hagel- und Pilzschäden an Fasernesselstengeln.** [Hail and fungal injuries on Fibre Nettle stalks.]—*Faserforsch.*, xv, pp. 38–40, 1940. [Abs. in *Zbl. Bakt.*, Abt. 2, cvi, 1–4, pp. 73–74, 1943.]

Whereas hail injuries do not impair the utility of nettle stalks for fibre production, the portions invaded in a secondary capacity by *Cladosporium elegans* cannot be detached, since the mycelium penetrates the cortex and envelops the fibres, which in this way become bound to the cambium. The development of the pathogen is favoured by liberal nitrogenous manuring and heavy precipitation.

Calvert (E. L.) & Muskett (A. E.). **Blind seed disease of Rye-Grass.**—*Nature, Lond.*, cliii, 3879, pp. 287–288, 1944.

In further investigations carried out in Northern Ireland on the infection of rye grass [*Lolium perenne* and *L. multiflorum*] by blind-seed disease (*Phialea temulenta*) [*R.A.M.*, xxi, p. 455, and cf. next abstract], the authors observed sporodochia producing endogenous microspores on affected seeds and in culture. In inoculation tests *Pullularia pullulans* was found to be non-parasitic [cf. ibid., xix, p. 709]. When the blind-seed fungus was used in suspensions of ascospores and macrospores, heavy infection resulted at flowering time on one commercial type and two indigenous strains of perennial and one commercial type of Italian rye grass. When inoculations were made after fertilization, the amount of infection rapidly declined. When the seed produced was tested, highly significant negative correlations were obt ainedbetween percentage infection and percentage germination for each variety.

The blind-seed fungus was isolated from *Festuca ovina*, *Agrostis canina*, *A. palustris*, *Poa pratensis*, *Holcus lanatus*, and *Cynosurus cristatus*. Cultures from the first three hosts and one from rye grass gave successful infection on *F. elatior*, *P. trivialis*, and rye grass.

In laboratory, pot, and field tests, full control followed hot-water seed treatment (15 minutes at 50° C.) preceded by four hours' immersion in tepid water, or 30

minutes at 50° without pre-immersion. When the seed was dried immediately after treatment, little, if any, reduction in germination resulted.

In a field test in which the plots were separated by paths 2 yds. wide, no treatment reduced infection in the seed produced, ascospores being carried from plot to plot and setting up primary infection. Small plots remote from rye grass crops were then sown with infected, treated seed, and similar plots in other areas with untreated seed. Examination of the seed produced showed that the percentage infection in 10 of the plots sown with untreated seed ranged from 0 to 38 per cent. (mean 8), while in 15 plots sown with treated seed the figures were 0 to 55 (mean 11) per cent. These results indicate that infection had occurred from some source other than the seed.

Examination of numerous seed samples since 1939 clearly showed that strains of indigenous perennial rye grass are more susceptible to the disease than commercial types. The amount of infection present in a crop was found to be influenced by the previous cropping, and it was also ascertained that seed samples from fields sown with heavily infected seed did not, on the average, show higher infection than those from fields sown with seed almost free from the disease.

As rye grass is mainly used as a forage crop and the seed is used chiefly for propagation, too much importance can be placed on reduced germination. Until evidence is forthcoming that the disease reduces the value of the crop, it must be assumed that the damage is restricted to an attack on the seed. The seed from indigenous strains is more liable to heavy infection than seed from commercial types, but if the indigenous crops are of much greater feeding value, then reduction in germination is of secondary importance. In Northern Ireland there would be few seasons when, by proper blending, the seed could not be brought up to a standard of germination suitable for incorporation in mixtures intended for pasture establishment in areas not producing seed. The best seed should be kept for distribution in seed-producing areas. In this way a supply of seed of the valuable indigenous strains would be made available until leafy, resistant strains can be introduced.

The occurrence of seasons when the germination of rye grass seed is low is attributed to the incidence of the blind-seed disease, which must therefore be regarded as of long standing.

Neill (J. C.) & Hyde (E. O. C.). **Blind-seed disease of Rye grass, II.** — *N.Z.J. Sci. Tech.*, xxiv, A, 2, pp. 65–71, 3 figs., 1942. [Received March, 1944.]

Further investigations into blind seed disease of rye grass [*Lolium perenne*] in New Zealand [*R.A.M.*, xviii, p. 601, and cf. preceding abstract] gave the following additional hosts: *Festuca arundinacea*, *F. elatior*, and *F. rubra* var. *fallax*. In four of five samples of infected rye grass seed oven-drying prevented the growth of the fungus without reducing seed germination. A general inverse correlation was established between the amount of pre-harvest infection and the germination of the crop. Air-dried macroconidia retained their vitality for 12 days at laboratory temperatures, but germination subsequently declined both in numbers and in rate until the 26th day, after which no further germination was noted. One small experiment indicated that systemic infection does not occur.

Apothecia were readily produced from infected seed of the current year's harvest by scattering seeds on or just under the surface of moist sand in Petri dishes, keeping them at 3° to 4° C. for one to four months, and then exposing them to the light at laboratory temperatures. The sound seeds germinated, but the seedlings soon died, and did not interfere with the apothecia that developed from the blind seeds. Microconidial sporodochia usually appeared on the infected seeds before removal from the refrigerator, and apothecia in six weeks to three months after. Apothecia were not produced in culture. It was found that the microconidia

were liberated in succession from within the tubular apex of the sterigmata in the manner characteristic of *Endoconidium temulentum* as described by Prillieux and Delacroix. In a feeding trial infected seed showed no toxic effect on sheep.

In an addendum the authors state that they obtained rye seeds from the original collection (Dordogne, 1891) on which Prillieux and Delacroix erected the genus and species *E. temulentum* and the apothecial form *Phialea temulenta*. Most of the seeds were coated with dry conidia indistinguishable from macroconidia of the blind-seed fungus. Sections showed the ramification of hyphae within the endosperm, as described by Prillieux and Delacroix, and the epidermal development of macroconidia, typical of blind seeds of rye grass, tall fescue (*F. arundinacea*), and darnel (*L. temulentum*). Apothecia of the blind-seed fungus and those described for *P. temulenta* were alike except for measurements of asci and ascospores, so that blind-seed disease and 'seigle enivrant' appear to be due to the same fungus, *P. temulenta*. This name has been changed twice—by Prillieux (1897) to *Stromatinia temulenta* and by Saccardo (1906) to *Sclerotinia temulenta*. As *Stromatinia* is invalid and the fungus is certainly not a *Sclerotinia* it appears that the original name *P. temulenta* should stand.

In a second appendix it is stated that apothecia have now been produced in the laboratory from rye and darnel seeds taken from heads artificially inoculated with blind-seed conidia from darnel. Ascospores from these apothecia produced typical macro- and microconidia. These apothecia agree with those described in the authors' earlier paper, except that the dimensions are larger. There appears to be no justification for the name *P. mucosa* [ibid., xxi, p. 456] in respect of host, life-history, pathology, macroconidia, microconidia, apothecia, asci, or ascospores. The measurements as given by Prillieux are: asci 130 by 5, and spores 10 by 4·5 μ, while those given by Miss Gray for *P. mucosa* are 66 to 116 by 3·3 to 7 and 7·6 to 12 by 3·6 μ, respectively, the authors' measurements being, on *L. perenne*, 70 to 80 by 4·5 to 5 and 7 to 8 by 3 to 4 μ, and on rye 76 to 121 by 4·8 to 6·4 and 5·5 to 9·5 by 3·5 to 4·8 μ. These differences scarcely have taxonomic value.

MUSSER (H. B.) & THORNTON (J. K.). **Local, domestic and foreign Red Clover seed.**—*Bull. Pa agric. Exp. Sta.* 458, 17 pp., 1 fig., 1943.

The following points of phytopathological interest emerge from a survey of the tests of red clover strains of diverse origins which have been carried on intermittently since their inception in 1921. Seed from Virginia, Kentucky, and Tennessee, generally considered to be resistant to southern anthracnose (*Colletotrichum trifolii*), produced satisfactory yields over a protracted period, and a blend of the best strains of this material is being increased, in co-operation with the United States Department of Agriculture, under the name of Cumberland [*R.A.M.*, xxiii, p. 22]. Similar arrangements have been made in connexion with Midland [loc. cit.], another satisfactory combination of two identified strains from Ohio and one from Illinois. In general, the disease problem is not acute in the northern clover-growing region, but northern anthracnose (*Kabatiella caulivora*) contributes to yield reductions in the central districts, comprising Ohio, Iowa, Indiana, Illinois, West Virginia, part of Maryland, and central and western Pennsylvania.

CARRERA (C. J. M.) & NOLL (W.). **La importancia de algunas species de 'Fusarium' en el pietín y marchitamiento de 'Lupinus albus', 'Lup. angustifolius' y 'Lens esculenta' en el Uruguay.** [The importance of some species of *Fusarium* in the foot rot and wilt of *Lupinus albus*, *Lup. angustifolius*, and *Lens esculenta* in Uruguay.]—*An. Soc. cient. argent.*, cxxxi, 4, pp. 152–184; 5, pp. 185–211, 15 figs., 1941. [German and Italian summaries. Received December, 1943.]

This is an exhaustive study of a foot rot and wilt of white and blue lupins (*Lupinus albus* and *L. angustifolius*) and lentils observed, for the first time in

Uruguay, in 1938–9, on the experimental plots of the 'La Estanzuela' Phytotechnical Institute, where it caused substantial damage. Previous contributions to the knowledge of lupin fusarioses are summarized and discussed, but no record of the lentil being affected has been found. Distinctive features of the disease include the destruction of the root tissues, infection proceeding from the exterior to the interior; penetration of the hyphae into the vascular system of the roots and stem bases; a reddish-brown discoloration of the vessels up to a few centimetres above the externally recognizable zone of invasion; and the more or less sudden onset of wilting, accompanied by the premature death of the plants.

The diseased material yielded the following species: *Fusarium avenaceum* (seven isolates from eight white, seven from eight blue lupins [*R.A.M.*, xviii, p. 832], and four from six lentils), *F. scirpi* var. *acuminatum* (one from white, five from blue lupins, and four from lentils), *F. oxysporum* var. *aurantiacum* (five from white and one from blue lupins), *F. solani* (one each from white and blue lupins), *F. orthoceras* (one from blue lupins), and *F. culmorum* (two from lentils). All these species are new records for eastern Uruguay.

All the organisms were pathogenic in varying degrees to their own hosts in inoculation experiments, the most virulent symptoms being induced by *F. avenaceum* on both lupins and lentils and by *F. scirpi* var. *acuminatum* on *L. angustifolius*. The infection caused by *F. solani* on lupins was noticeably mild, while the attacks of *F. orthoceras*, *F. oxysporum* var. *aurantiacum*, and *F. culmorum* were of intermediate severity. In cross-inoculation tests *F. avenaceum* and *F. scirpi* var. *acuminatum* from white lupins and lentils, and *F. orthoceras* from the latter, were equally pathogenic to blue lupins, showing no decided preference for their own hosts. In general, the symptoms developing on inoculated plants agreed with those observed in the field, and reisolations established the identity of the causal organisms. *F. orthoceras* and *F. solani* are stated to be the only species, among those under investigation, previously implicated in the causation of wilt and foot rot (of blue lupins). The individual species could not be differentiated on the basis of the appearance of the infected plants, which responded similarly, though in differing degrees, to all the pathogens.

Both in the open and in inoculation experiments, the damage from the fusarioses was more extensive in hot than in cool weather, but further investigations are required to base control measures on this factor.

Hardison (J. R.). **Specialization of pathogenicity in Erysiphe graminis on wild and cultivated grasses.**—*Phytopathology*, xxxiv, 1, pp. 1–20, 1944.

At the Kentucky Agricultural Experiment Station the writer studied 318 accessions of 18 species and nine varieties of 25 genera of wild and cultivated grasses, besides 15 varieties of barley, one of rye, two of summer wheat, and one of oats in respect of their reaction to eight cultures of *Erysiphe graminis*. All the cultures used in the trials infected species of two or more genera, this result disproving previous conclusions as to the restriction of pathogenicity to a single host genus.

The inoculation technique, based on the scattering or dilution method of Mains [*R.A.M.*, ix. p. 58] and Tidd [ibid., xvi, p. 376], is fully described. The five reaction types of Mains and Dietz [ibid., ix, p. 643] were employed, the experimental data being tabulated and the significant points discussed.

Culture 18 from rye at Yakima, Washington, was almost completely confined to its own host, the only other infection being a very mild one on *Agropyron spicatum*. The freedom from mildew of the other grasses tested is stated to constitute the first large-scale evidence of the non-pathogenicity to extraneous hosts of *E. graminis* from rye.

Culture 2 from summer wheat at Ann Arbor, Michigan, severely attacked

Aegilops crassa, *A. cylindrica*, *Agropyron striatum*, *Elymus condensatus*, and *E. junceus*, while *Aegilops triuncialis*, *Agropyron inerme*, *A. spicatum*, *E. canadensis*, *E. dahuricus* *E. triticoides*, *E. glaucus*, *E. sibiricus*, and *Sitanion hystrix* were moderately susceptible, and *S. jubatum* semi-resistant to the mildew from this source, which was hitherto recorded only on *Aegilops* outside the genus *Triticum* [ibid., xii, p. 362]. Culture 2 would appear, from a comparison of the author's results with those of Mains [loc. cit.], to be identical with the latter's physiologic race 1.

The Arlington C.I.702 and Hanna C.I.906 barley varieties were highly resistant to culture 3 from the same host (Ann Arbor), Duplex C.I.2433, Goldfoil C.I.928, Heil's Hanna C.I.682, and 244 C.I. 1021 very resistant, Black Hull-less C.I.666, Common Chile C.I.663, Lynch C.I.919, and Nepal C.I.595 moderately resistant, Coast C.I.276, Oderbrucker C.I.940, and Peruvian C.I.335 moderately susceptible, and Horsford C.I.877 and Malting C.I.1129 very susceptible. *Agropyron intermedium* and *A. trachycaulum* proved moderately susceptible to culture 3, *A. striatum* moderately resistant, and *A. spicatum* and *E. glaucus* very resistant, this being the first record of infection by barley mildew on grasses outside the genus *Hordeum*.

The Horsford C.I.147 and Malting C.I.326 barleys were very susceptible to a mixed culture from *A. repens* (Yakima). The mildew on barley was increased and designated culture 7, while the other component was numbered 6. The latter was the most aggressive of all the cultures tested, being more or less pathogenic to all *A.* spp. and also attacking *Aegilops cylindrica*, nine species or varieties of *Elymus*, *Hystrix patula*, *S. hystrix*, and *S. jubatum*. This wide infection range is in sharp contrast to the concept of narrow specialization of the *Agropyron* mildew advanced by Marchal (*C.R. Acad. Sci., Paris*, cxxxvi, pp. 210–212, 1902) and heretofore accepted by later workers. To culture 7 the Arlington C.I.702, Goldfoil C.I.928, Horsford C.I.147, Malting C.I.326, and Peruvian C.I.925 barleys were very susceptible and Black Hull-less C.I.666 and Nepal C.I.595 moderately resistant. *A. repens*, its own host, was the only wild grass reacting with any appreciable degree of susceptibility to this culture, the virulence of which to Arlington C.I.702 differentiates it from all previously described races of *Erysiphe graminis hordei* in the United States.

Two isolates from a bulk culture of the mildew from *Elymus dahuricus* (Ann Arbor) were studied, viz., culture 10, originating from the inoculation of Malakoff C.I.4898 wheat by conidia of the mixed culture, and 11, isolated on *A. desertorum* similarly inoculated. Culture 10 attacked numerous species of *Aegilops*, *Agropyron*, *Elymus*, *Hystrix*, *Sitanion*, and *Triticum*; the Malakoff C.I.4898 and Axminster C.I.1839 wheats were very susceptible and moderately resistant, respectively. Culture 11, on the other hand, was capable of infecting only *A.* and *E.* spp.

Culture 13 from *E. condensatus* (Pullman, Washington) was more or less pathogenic to most of the *A.* and *E.* spp. tested and very mildly so to *S. hystrix*. It is comparable in several respects to 11, including the brownish colour of the mycelium in both, but the two collections are distinguishable on the basis of the reactions of various grass accessions.

The differences in reaction to *Erysiphe graminis* of strains within grass species are of importance in the selection of economic grasses. Several selections have shown outstanding resistance to all the cultures.

Grasby (C. G.). **Some common pests and diseases in the Murray Irrigation Areas.** *J. Dep. Agric. S. Aust.*, xlvii, 4, pp. 152–158, 8 figs., 1943.

A spray programme for fruit-growers in the Murray Irrigation Area, South Australia, is given, designed for the control of various insect pests and fungal diseases of stone fruits, citrus, and vines.

Taylor (G. G.) & Brien (R. M.). **Ripe-spot of Apples (Neofabraea malicorticis).** —*N.Z. J. Sci. Tech.*, A, xxv, 2, pp. 63–72, 8 figs., 1 graph, 1943.

In connexion with the increasing importance of apple ripe spot (*Neofabraea malicorticis*) in New Zealand the symptoms of the disease and the morphology of the pathogen are described, and the incidence and economic importance of the trouble and the factors affecting it discussed. The fungus has been reported from all fruit-growing districts, but most of the damage occurs on the highly susceptible Sturmer variety in the Nelson area. Factors contributing to a high percentage of infection include late picking, delay in placing the fruit in storage, and unduly high storage temperatures. The comparative features of ripe spot and similar types of infection occurring on New Zealand apples are tabulated, with additional notes for assistance in diagnosis.

Kidson (E. B.), Askew (H. O.), & Chittenden (E.). **The value of magnesium compounds for the control of magnesium deficiency of Apple trees.** *N.Z. J. Sci. Tech.*, A, xxv, 1, pp. 31–42, 4 figs., 1943.

Magnesium compounds supplying approximately 500 or 1,000 gm. magnesium oxide per tree, applied in the winter of 1939 to 1940 to apple trees in two localities in the Nelson district of New Zealand, produced a gradual improvement [*R.A.M.*, xix, p. 604] during the three following seasons, notably in Sturmers, the other varieties (Delicious, Jonathan, and Cox's Orange) included in the trials reacting less satisfactorily. The element was given in the form of top dressing as sulphate, carbonate, or dolomite, of which the first two acted more rapidly, while the beneficial effects of the third became more noticeable with time. The increased magnesium contents of the leader leaves of the treated trees were mostly consistent with the degree of visible recovery. As in the previous experiments, magnesium salt injections maintained individual branches in good health on magnesium-deficient trees.

Cullinan (F. P.) & Batjer (L. P.). **Nitrogen, phosphorus and potassium interrelationships in young Peach and Apple trees.** *Soil Sci.*, lv, 1, pp. 49–60, 1 graph, 1943.

In the six years' experiments at the Bureau of Plant Industry, United States Department of Agriculture, the vegetative growth of Elberta peach and York apple trees was found to be markedly affected by an inadequate supply of nitrogen in the nutrient solution. Under these conditions the effects of low phosphorus or low potassium on growth are not conspicuous, but with a high nitrogen level (upwards of 60 p.p.m.), deficiency symptoms develop when either phosphorus or potassium is present in low concentration, peaches suffering much more severely than apples. Full details of the results are given.

Willison (R. S.). **Brown rot and other fungal wastage in harvested Peaches.**—*Sci. Agric.*, xxiv, 5, pp. 221–233, 6 graphs, 1944.

In spraying tests carried out in Ontario from 1938 to 1942, inclusive, for the control of peach brown rot [*Sclerotinia fructicola*: *R.A.M.*, xviii, p. 535], incidence during the first week after harvest was reduced by 40 to 65 per cent. in the worst years and by 65 to 100 per cent. in the other years by a four-spray schedule consisting of (pre-blossom 'shucks') koloform, kolofog, Bartlett's standard wettable sulphur, lime sulphur (1–50) or C.O.C.S., ('shucks') koloform, kolofog, Bartlett's standard wettable sulphur (all three with lead arsenate, zinc sulphate, and lime), or aero-sulphur; (three weeks before harvest) koloform, kolofog, standard wettable, and aero; and (pre-pick) kolopick or dust, kolopick or kolopre-pick, Bartlett's pre-pick or dust, ferrox flotation sulphur, or aero sulphur.

The weather experienced in the early part of the season may exercise a marked effect on control, through its influence on spore load and, perhaps, on the inherent susceptibility of the fruit, giving rise to what is termed the basic incidence of infection for the season. In view of the unpredictability of local weather, all four sprays should be applied, the third at not more than three weeks, and the last a day or two, before harvest is expected. As the sprays are more fungistatic than fungicidal, spraying should not be regarded as a substitute for other precautions. For instance, peaches should not be handled when wet or allowed to become damp after picking. Wrapping the fruits in tissue reduced the likelihood of contamination in the pack.

The evidence showed that brown rot infection can occur at 33° F. At this temperature, however, incubation is prolonged, so that, for practical purposes, prompt refrigeration at or below 45° is satisfactory. When the transportation period is over one week, storage at 33° is recommended; for shorter periods, 45° is satisfactory. During the first few days after the removal of peaches to room temperature, the rate of incidence of brown rot declines as the storage temperature is gradually brought down to 32°, but it rises again as the period in cold storage is increased.

Rot due to *Rhizopus nigricans* [*R. stolonifer*] was not found on peaches during refrigeration, but was sometimes serious after storage. It rarely appeared at room temperature until the second week after picking, except when the pack was damp. It tended to spread from fruit to fruit forming nests of rot, and did not appear to respond to spraying.

KEITT (G. W.), MOORE (J. D.), CALAVAN (E. C.), & SHAY (J. R.). **Occurrence of the imperfect stage of Sclerotinia laxa on Prunus cerasus in Wisconsin.**—*Phytopathology*, xxxiii, 12, pp. 1212–1213, 1 fig., 1943.

In June, 1941, *Sclerotinia laxa* was isolated on potato dextrose agar from the internal tissues of severely blighted Montmorency and Early Richmond cherry varieties in Door County, Wisconsin. In the spring of 1942 the sporodochia of the fungus were observed in profusion on the blighted fruit spurs of the preceding year, as well as on the remnants of the petioles and midribs of the leaves and persistent parts of the overwintered diseased blossoms. Although a severe local outbreak of the blight occurred at this time, no sporodochia could be found on the current season's lesions, but in the spring of 1943 a few of these organs did develop on recently produced infections. Inoculation experiments with pure cultures of *S. laxa* on Montmorency blossoms and twigs gave positive results, the pathogen being reisolated from the diseased tissues and successfully used in re-inoculation tests. This is believed to be the first record of *S. laxa*, the common agent of brown rot in Europe, Manchukuo, and Japan, for central or eastern North America.

KEITT (G. W.) & MOORE (J. D.). **Masking of leaf symptoms of Sour-Cherry yellows by temperature effects.**—*Phytopathology*, xxxiii, 12, pp. 1213–1215, 1943.

Particulars are given of bud-grafting experiments at Madison, Wisconsin, in 1942–3 with the cherry yellows virus [*R.A.M.*, xxii, p. 440], the results of which demonstrated the masking effect on the foliar symptoms on the Montmorency variety of constant temperatures of or exceeding 20° C. At 16°, on the other hand, the typical features of the virus are clearly expressed.

FOX WILSON (G.) & GREEN (D. E.). **Observations on two Raspberry troubles.**—*J. R. hort. Soc.*, lxix, 3, pp. 79–86, 1 fig. (facing p. 71), 1944.

The examination of raspberry canes suffering from progressive deterioration at the Royal Horticultural Society's Gardens, Wisley, Surrey, disclosed the

presence of two organisms, viz., the cane midge, *Thomasiniana theobaldi*, and the cane blight fungus, *Leptosphaeria coniothyrium*. The question as to the relative severity of the two pathogens and their possible etiological connexions is left open pending further studies.

The stocks most heavily damaged by *L. coniothyrium* in 1941 were some East Malling seedlings and the Newburgh variety. In the following year the trouble was equally acute, and was observed to be spreading to other varieties. Excision of the diseased material, combined with the application of Bordeaux mixture, failed to control the blight in 1942–3: the results of subsequent tests in the latter year, in which all the old canes, both healthy and infected, were eliminated, will not be apparent until the 1944 season. It seems evident that the critical period for the invasion of the canes by *L. coniothyrium* is at a very early stage of growth, possibly on their first emergence from the soil, so that timely spraying is essential, but much more information is required concerning the life-histories both of the cane midge and the blight fungus before rational control measures can be instituted.

Wallace (G. B.). **Diseases of Papaws.** *E. Afr. agric. J.*, ix, 3, pp. 175–176, 1944.

A preliminary account is given of a disease of papaw found recently on a few estates in Northern Province, Tanganyika Territory. The condition, which appears to be due to a species of *Pythium* or *Phytophthora*, or, more probably, to more than one species, causes a certain amount of damage to individual fruits, and is capable of killing seedlings and mature trees. In general, only a few succumb, and the cumulative amount of loss may not at first be appreciated.

The disease attacked 20 per cent. of the seedlings in a large field on Kilimanjaro in June and July, 1943. The effect was a damping-off or foot rot. The roots seemed healthy, but dark, water-soaked lines ran up the stems. Older seedlings were shrunken, dried, and flattened.

In older trees the fungus can attack the roots and collar, but most infections occur in the upper parts. The fungus generally effects its entry at the scars left by fallen leaves, flowers, or fruits. When it penetrates an old leaf scar below the existing foliage, it causes a rotting of the stem: the part above falls over, leaving only the bare stem standing. This may send out new shoots from below. When the fungus enters a scar among the leaves and fruits, it spreads to the leaf-stalks or fruits, causing them to fall off. Many fallen fruits show the rot, but most infections of fallen fruits appear to arise after they have dropped.

In some trees the collar and upper roots are soft and rotten. This usually marks the disease as it occurs in South Africa, where it is known as 'foot rot' [*R.A.M.*, xi, p. 330; cf. xxi, p. 150]. Trees so affected show wilting and yellowing of the foliage, followed by leaf fall, and are easily blown or pushed over. Preventive measures based on South African experience consist in providing good growing conditions and in avoiding injury to the plants; in affected seed-beds the soil should be treated with Cheshunt compound and the sowings made thinly. The same compound should be used for watering the soil after removal of affected plants from the field. If the upper parts of the trees are affected, control depends on field sanitation. All affected material should be destroyed and replanting should not take place until a suitable period has elapsed. Where a papaw field adjoins the overgrown banks of a river, a clear, uncultivated area should be made.

Other papaw diseases found locally are mildew (*Ovulariopsis papayae*) [ibid., xii, p. 680], for the control of which sulphur dusting is suggested, and anthracnose (*Colletotrichum gloeosporioides*) [ibid., xxi, p. 149].

Loustalot (A. J.). **Apparent photosynthesis and transpiration of Pecan leaves treated with Bordeaux mixture and lead arsenate.** *J. agric. Res.*, lxviii, 1, pp. 11–19, 5 graphs, 1944.

In an investigation carried out in Texas in 1941 mature leaves of a 10-year old

pecan tree carrying a full crop of nuts were treated on three occasions in June and July with 6-2-100 and 8-8-100 Bordeaux mixture and in two experiments in September and October with 6-100 lead arsenate. In every case the material was applied to both surfaces by dipping the leaves twice into an agitated, freshly prepared mixture and allowing the material to dry between the immersions. The spray material had thoroughly dried when the determinations of apparent photosynthesis or transpiration were made. In no instance did either treatment have any appreciable effect on these processes.

STODDARD (E. M.) & HEUBERGER (J. W.). **Eradicant action of fungicides on spores on living plants.**—*Phytopathology*, xxxiii, 12, pp. 1190–1195, 1943.

The writers' studies at the Connecticut Agricultural Experiment Station were concerned solely with the eradicant action of fungicides on the spores present on living plants, and the measurement of this effect in terms of spore mortality and its relation to subsequent control of the fungus. This aspect of combating plant diseases has hitherto received little attention, interest having been much more widely focussed on the protective action of fungicides on the host, manifested in the prevention of spore development. The pathogens used in the tests were carnation rust (*Uromyces caryophyllinus*) and apple scab (*Venturia inaequalis*), and the fungicides were tetrachloro-para-benzoquinone (spergon), tetramethylthiuram disulphide (Japanese beetle spray), ferric dimethyl dithiocarbamate (fermate), mercaptobenzothiazole (captax), dinitro-ortho-cresol dye (elgetol), liquid lime-sulphur, wettable sulphur (mike), copper oxychloride (compound A), yellow cuprous oxide (yellow cuprocide), and Bordeaux mixture.

The carnation rust experiments were conducted in the greenhouse, a total of four treatments being given on 29th January, 6th and 20th February, and 13th March. Thirty-five days after the last application the percentage of spore germination (based on 600 spores from 30 leaves per treatment) in aqueous suspensions (5,000 to 1 c.c.) incubated overnight at 20° C. for the controls, tetramethylthiuram disulphide, tetrachloro-para-benzoquinone, ferric dimethyl dithiocarbamate, mercaptobenzothiazole (all at 0·25 per cent.), and mike wettable sulphur (0·75) were 63, 6, 8, 22, 62, and 61, respectively, the corresponding figure for yellow cuprous oxide (0·25) after 17 days being 43, and the number of new infections per 1,000 leaves (above the level obtaining at the commencement of the programme) 20·6, 0·9, 1·7, 1·8, 6·4, 6·1, and 7·8, respectively. It is apparent from these data that a correlation exists between spore mortality and the incidence of fresh infections.

For the apple scab tests overwintered leaves were placed under two-year-old McIntosh trees in the field early in April. Ascospores were discharged on 15th and 16th May, and lesions appeared on the foliage on the 27th. On 5th June five trees in each of four replicated blocks were sprayed with two dosages of the various fungicides (0·25 and 0·0625 per cent.), and on 16th June their effects on conidial mortality were determined by 48 hours' incubation of suspensions from scab lesions on 40 leaves, chosen at random from the 80 collected for each dosage. On 21st July the new leaves produced after the completion of spraying were divided into two groups, representing the side and top branches, to ascertain the possible influence on scab incidence of the washing by rain of the eradicants from the sprayed to the untreated foliage, and counts made of the fresh infections occurring after the termination of spraying. The percentage of conidial germination ranged from nil for fermate and yellow cuprocide (both concentrations) to 74 per cent. for elgetol (0·0625 per cent.), the figure for the control being 64 per cent.; substantial reductions were also effected by Japanese beetle spray (1·5 and 2 per cent. for the two concentrations) and mike sulphur (2·5) at the higher strength. The percentages of diseased leaves on the treated side branches ranged from 16

(yellow cuprocide, 0·25 per cent.) to 77 (lime-sulphur, 0·0625), and on the top ones from 7·5 (yellow cuprocide, 0·25 per cent.) to 36·5 (mike sulphur, 0·0625), the corresponding figures for the controls being 74·8 and 30·2 per cent., respectively. As in the case of carnation rust, there was a general agreement between high spore mortality and a low incidence of reinfection. The new leaves on the side branches were uniformly more severely damaged than those on the top ones, indicating that the washing of fungicides from the sprayed to the untreated foliage had little or no bearing on control; the amount of scab on the unsprayed foliage, therefore, is directly related to the eradicant value of the materials. The most powerful eradicant, yellow cuprocide, was likewise the most detrimental to the foliage, but this property was left out of account in the present experiments.

Frear (D. E. H.). **Chemistry of insecticides and fungicides.**—viii+300 pp., 17 figs., 7 diags., 7 graphs, New York, D. Van Nostrand Company, Inc., 1942.

The text of this book is the outgrowth of the author's lecture notes and reference compilations prepared as the basis for a graduate course in the chemistry of insecticides and fungicides at the State College of Pennsylvania. Part III is concerned with fungicides, chapter X dealing with the copper compounds and XI with those of mercury, miscellaneous fungicides, and wood and cellulose preservatives. Part IV also comprises two chapters: XII describing wetting, spreading, and emulsifying agents, and XIII spray residue removal. Macro- and micromethods of analysis are discussed in part V.

Proprietary products for the control of plant pests and diseases. List of officially approved products.—4 pp., issued jointly by Minist. Agric., Lond., and Dep. Agric. Scotland, 1944.

This first list of proprietary fungicides and insecticides approved by the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland under the official approval scheme [*R.A.M.*, xxiii, p. 33], contains six groups of products: A, lead arsenate powders; B, lead arsenate pastes; C, lime-sulphur washes; D, miscible tar oil winter washes; E, stock emulsion tar oil winter washes; and F, organo-mercury dry seed dressings, the last-named group consisting of abavit B, agrosan G, ceresan, harvesan, leytosan, leytosan C. C., lunasan, and Swain's triangle brand. Products in groups other than those shown in the list have not yet become eligible for consideration under the scheme, and will be dealt with at a later date. Further lists will be issued periodically in similar leaflets, and additions to the list made before the next issue will be published in *J. Minist. Agric.*

Hertz (M. R.) & Levine (M.). **A fungistatic medium for enumeration of yeasts.**—*Food Res.*, vii, 6, pp. 430–441, 5 figs., 1942.

Yeasts being of much greater importance than moulds as agents of deterioration in carbonated beverages, it was desirable to evolve a method for the independent determination of the relative incidence of these two groups. At the Iowa State College the writers successfully used for this purpose a malt extract agar medium with an admixture of 100 p.p.m. diphenyl [*R.A.M.*, xxi, p. 13], which exerted a marked fungistatic action for a period of 72 to 96 hours on a large number of moulds, including *Penicillium expansum*, *Mucor hiemalis*, *Aspergillus fumigatus*, and *Fusarium graminearum* [*Gibberella zeae*], while permitting the luxuriant growth of most of the yeasts tested. *Rhizopus nodosus* and *R. nigricans* [*R. stolonifer*], however, proved refractory to the action of diphenyl even at a strength of 500 p.p.m. In the presence of diphenyl a pink yeast failed to produce its pigment, and the mycelium of *A. niger* was of a vivid yellow colour, while conidial development was inhibited.

WILKOWSKE (H. H.) & RENNER (K. M.). **A rapid method of churning cream into butter for mold mycelia determinations.**—*J. Dairy Sci.*, xxvi, 3, pp. 283–287, 1943.

A rapid method of churning cream into butter for mould (*Oospora lactis*) mycelia determinations by the standard methods approved by the (United States) Federal Food and Drug Administration [*R.A.M.*, xx, p. 205 *et passim*] has been developed at the Texas Technological College. It involves churning the cream by means of a malt-mixer and counting the mycelia in the butter thus produced. There were no statistically significant differences between the mould mycelia counts of butter samples churned by the malt-mixer method and those churned in commercial butter plants. The new technique is simple, accurate, and applicable to the study both of mould in cream and in the butter prepared therefrom.

PUCK (T. T.), ROBERTSON (O. H.), & LEMON (H. M.). **The bactericidal action of propylene glycol vapor on microorganisms suspended in air. II. The influence of various factors on the activity of the vapor.**—*J. exp. Med.*, lxxviii, 5, pp. 387–406, 2 diags., 2 graphs, 1943.

The bactericidal action of propylene glycol vapour on air-suspended micro-organisms [*R.A.M.*, xx, p. 259] was shown to reach a maximum intensity at a temperature below 80° F. and an atmospheric relative humidity between 45 and 70 per cent. The disinfectant exerted as powerful an effect when dispersed in an 800 cu. ft. room as in chambers of 2 cu. ft. capacity. The minimum propylene glycol concentration required for the destruction of pneumococci was 1 gm. in 20,000,000 c.c. air, while from 1 to 5,000,000 and 1 to 10,000,000 were necessary to produce comparable results on the streptococci and staphylococci.

McCOMB (A. L.). **Mycorrhizae and phosphorus nutrition of Pine seedlings in a prairie soil nursery.**—*Res. Bull. Ia agric. Exp. Sta.* 314, pp. 582–612, 10 figs., 1943.

During the spring of 1937 the first crops of conifers were seeded at the Iowa State Forest Nursery, which is situated on an O'Neil sandy loam. The species included northern white pine (*Pinus strobus*), ponderosa pine (*P. ponderosa*), Virginia pine (*P. virginiana*), and Japanese red pine (*P. densiflora*), all of which were mulched with pine needles from a vigorous 14-year-old plantation of white and red pines. Other conifers seeded but not mulched with pine needles included red or Norway pine (*P. resinosa*), Austrian pine (*P. nigra*), Douglas fir (*Pseudotsuga taxifolia*), and Norway spruce (*Picea abies*).

By about 1st August it was noticed that the beds mulched with pine needles had a spotted appearance. In certain parts of these beds the seedlings were making vigorous growth, while in others they were stunted. The seedlings not mulched with pine needles were all stunted. The difference between the good and bad places in every bed became progressively more conspicuous. In late September the stunted seedlings began to turn brown or reddish-purple, though the vigorous ones were a normal green. At the termination of the growth period the vigorous seedlings were about twice the size of the stunted ones.

Examination revealed that the vigorous seedlings all possessed abundant ectotrophic mycorrhiza, though the stunted seedlings had few or none. This relationship held for all seedlings from beds mulched with pine straw, and was most marked with Virginia and Japanese red pines. The seedlings from beds of Austrian and red pine, Douglas fir, and Norway spruce, which had not received the needle mulch, were uniformly poor and none showed ectotrophic mycorrhiza.

During the winter many of the non-mycorrhizal seedlings in the mulched beds died. During the second growing season, however, the size of the areas supporting vigorous seedlings increased, and many of the previously unhealthy seedlings

regained their greenness and made good growth. At the end of the second season all save a few of the areas previously showing stunting contained vigorous seedlings. In the beds not originally mulched with pine straw winter mortality was very conspicuous. In the late spring of the second season, however, a few small spots of vigorous seedlings appeared, and these seedlings were found to have mycorrhiza. These spots enlarged slowly, but by the close of the second season about 90 per cent. of the Douglas fir seedlings, and only a slightly lower percentage of the Austrian pine, red pine, and spruce were dead.

To ascertain if the pine needles used to cover the seed-beds were a source of mycorrhizal fungi inoculation of new coniferous seed-beds was attempted. In the spring of 1938 duff and humus-rich top soil were obtained from the plantation which had furnished the pine straw used for the 1937 seed-beds, it having been previously ascertained that the trees in this plantation bore mycorrhiza. This soil was applied at the rate of 1 bush. per 250 sq. ft. of seed-bed, and the bed was then sown to Scots pine (*Pinus sylvestris*). At the end of the second growing season (1939) many of the uninoculated seedlings were dead, while those still alive averaged under 2 in. in height, whereas the inoculated seedlings averaged 7 in. in height.

Inoculation of seed-bed soil with the same duff was attempted for other species, including white pine, jack pine (*P. banksiana*), and Douglas fir, with similar results; in all cases, marked stimulation of growth occurred and mycorrhiza appeared in the inoculated but not in the uninoculated plots.

A study of the nutrient content and root development of mycorrhizal and non-mycorrhizal pines from the State Forest Nursery was made, using Virginia pine stock. This showed that (1) green and dry weights of mycorrhizal plants were double those of non-mycorrhizal; (2) the total height of mycorrhizal plants was 35 per cent. greater, and height growth from cotyledons to bud 60 per cent. greater; (3) mycorrhizal plants were 17 per cent. longer from root-collar to cotyledons; (4) the average mycorrhizal plant had over 600 absorbing short roots and mycorrhizal tips or branches, while the non-mycorrhizal had only slightly over 300; (5) the number of non-mycorrhizal short roots on mycorrhizal and non-mycorrhizal plants was about equal; (6) the extra absorbing root tips on the plants from inoculated soil were thus mycorrhizal and can be regarded as extra root tips formed as a result of the mycorrhizal stimulus; (7) mycorrhizal plants contained (totals per plant) twice as much nitrogen and potassium and four times as much phosphorus as non-mycorrhizal plants; (8) on a percentage of dry-weight basis the seedlings with mycorrhiza contained twice as much phosphorus as non-mycorrhizal plants, but there was small difference in the contents of nitrogen and potassium. These data indicate that mycorrhiza, or the conditions that permit their formation, directly stimulated root growth and activity, and that the plants so stimulated were able to absorb increased amounts of phosphorus, an element which appeared to be limiting growth in this soil.

When conifers were grown on uninoculated soil, good growth followed phosphorus fertilization, though little or no response was obtained with nitrogen. Seedling growth following phosphorus fertilization was about equal to that obtained when unfertilized soil was inoculated with humus-containing mycorrhizal material.

Short roots of white pine seedlings from uninoculated O'Neil soil fertilized with phosphorus, nitrogen, and potassium showed ectotrophic mycorrhiza, and possessed a very compact mantle of fine mycelia. Short roots from seedlings on inoculated, unfertilized soil showed mostly ectendotrophic mycorrhiza with coarse hyphal threads. It is thought that two species of fungi may be involved, one of which may have been subdominant in the original nursery soil and unable to form mycorrhiza without phosphorus fertilization. The author suggests that failure of

non-mycorrhizal pines on O'Neil soil may be due to a low level of root respiration, which may be stimulated by secretions from mycorrhizal fungi and by phosphorus.

STELZNER (G.). **Zur Frage der Virusübertragung durch Samen, insbesondere des X- Y- und Blattrollvirus der Kartoffel.** [A contribution to the problem of virus transmission through seed, especially of the Potato X, Y, and leaf roll viruses.]—*Züchter*, xiv, p. 225, 1942. [Abs. in *Zbl. Bakt.*, Abt. 2, cvi, 1–4, pp. 58–59, 1943.]

The first part of this study is a compilation of previous reports on the transmissibility of various plant viruses through the seed, while the second is concerned with the experiments of the author and others on the conveyance of the potato X, Y, and leaf-roll viruses by this means. The presence of the X and Y viruses in the potato embryo and their subsequent inactivation on the separation of the seed from the mother plant were already known, and these observations were confirmed by the writer in respect both of potato and *Datura*, embryonic infection in which amounted to as much as 100 per cent. Both viruses lost their infective capacity during the ripening, storage, and germination of the seed. Kausche noticed a similar process of inactivation in connexion with the tobacco mosaic virus in Samsun seed, which he attributes to the influence of a substance produced during maturation and germination.

OSSIANNILSSON (F.). **Bladlöss som spridare av bladrullsjuka på Potatis i Sverige.** [Leaf aphids as vectors of leaf roll disease of the Potato in Sweden.]—*Växtskyddsnotiser, Växtskyddsanst., Stockh.*, viii, 1, pp. 15–16, 1944.

So far only two species of aphids have been experimentally proved to act as vectors of potato leaf roll in Sweden, viz., *Myzodes* [*Myzus*] *persicae* and *Aulacorthum* [*M.*] *pseudosolani* [*R.A.M.*, xxii, p. 446], of which the former occurs in the open as far north as Skellefteå and the latter up to Östersund. The prevalence of the aphids in potato fields in different parts of the country is under investigation.

LARSON (R. H.). **A foliar mottle and necrosis in Chippewa Potatoes associated with infection by a strain of the Potato X virus.**—*Phytopathology*, xxxiii, 12, pp. 1216–1217, 1943.

Attention is drawn to the occurrence on Chippewa potatoes in Wisconsin of a tuber-perpetuated disease somewhat resembling mild mosaic in varieties of the Cobbler and Triumph type, but distinguishable from it by characteristic irregular, chlorotic, mottled patches in the intercostal areas of the upper leaves of young plants and small, scattered, necrotic flecks on the older foliage. The tubers are slightly below normal size but not otherwise affected. The disorder was first observed in 1939, and subsequently in 1941, 1942, and 1943. Infection was mechanically transmitted to the Chippewa, Sebago, Triumph, Red Warba, and Russet Burbank varieties, and to F_1 selfed Katahdin seedlings, the first symptoms appearing in 12 to 15 days as small, irregular, scattered, necrotic lesions penetrating the thickness of the leaf; these were followed, first by a faint, interveinal, chlorotic mottling of the younger leaves, and then by the development of isolated necrotic flecks on the interveinal areas. Seedling 41956 is immune.

Connecticut Havana No. 38 tobacco and *Nicotiana rustica* inoculated with the Chippewa virus contracted well-marked ring-spot symptoms. Tobacco plants previously infected with a mottle strain of the potato X virus did not develop ring spot on reinoculation with the virus from Chippewa plants, thereby strongly indicating that the latter is an uncommon variant of X. Chippewa is highly resistant to mild mosaic and a masked carrier of the common X strains. In preliminary temperature studies the disease assumed a more virulent form at 16° to 20° than at 24° C., and was entirely suppressed at 28°.